# A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR , AN IN VIVO STUDY

*A Dissertation submitted to*

**THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY**

**CHENNAI- 600032**

*in partial fulfilment for the degree of*

**MASTER OF DENTAL SURGERY**

**BRANCH – III**

**DEPARTMENT OF ORAL & MAXILLOFACIAL SURGERY**

**2015 – 2018**

# CERTIFICATE

This is to certify that the Dissertation entitled **"A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE IN POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR 3RD MOLAR, AN IN VIVO STUDY "** is a bonafide work done by **Dr. DIVYA BHARATHI.M** Post Graduate student (2015-2018) in the Department of **ORAL and MAXILLOFACIAL SURGERY**, Madha Dental College & Hospital-Chennai-69 under the direct guidance and supervision in partial fulfillment of regulation laid down by **The Tamil Nadu Dr.M.G.R Medical University, Guindy, Chennai -32** for **Master of Dental Surgery**, Oral and Maxillofacial surgery (Branch III) Degree Examination.



**Dr. P.JAYAVELU, M.D.S.,**
Professor and Head
Department of Oral & Maxillofacial Surgery
Madha Dental College & Hospital,
Chennai - 600 069

# CERTIFICATE - II PLAGIARISM

This is to certify that this dissertation work titled "**A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR, AN IN VIVO STUDY"** of the candidate **Dr. DIVYA BHARATHI. M** with Registration Number **241515451** for the award of …… in the branch of Oral and Maxillofacial Surgery. I personally verified the urkund.com website for the purpose of plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **1%** percentage of plagiarism in the dissertation.

**Guide & Supervisor sign with Seal.**

## ENDORSEMENT BY HEAD OF THE DEPARTMENT / HEAD OF THE INSTITUTION

This is to certify that the Dissertation entitled **"A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE IN POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR, AN IN VIVO STUDY"** is a bonafide work done by **Dr. DIVYA BHARATHI. M**, Post Graduate student (2015-2018) in the Department of Oral and Maxillofacial surgery, under the guidance of **Dr. P. JAYAVELU, MDS.,** Professor, Department of Oral and Maxillofacial Surgery, Madha Dental College and Hospital, Chennai – 600 069.

**Dr. P.JAYAVELU, M.D.S.,**
Professor and Head
Department of Oral & Maxillofacial Surgery
Madha Dental College & Hospital,
Chennai - 600 069

**Dr. M.C.SAINATH, MDS,MBA, PGDCR.**
Principal
Madha Dental College And Hospital,
Kundratur, Chennai- 600069

# DECLARATION OF THE CANDIDATE

I, **Dr. DIVYA BHARATHI. M** hereby declare that this dissertation titled **"A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATION IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR, AN IN VIVO STUDY"** is a bonafide and genuine research work carried out by me under the guidance of **Dr. P. JAYAVELU, MDS., Professor,** Department of Oral and Maxillofacial Surgery, Madha Dental College and Hospital, Chennai -600069 **.**

**Dr. DIVYA BHARATHI. M**
Post Graduate Student
Department of Oral & Maxillofacial Surgery,
Madha Dental College and Hospital,
Kundrathur, Chennai.

Date :

Place :

# TRIPARTITE AGREEMENT

This agreement herein after the “Agreement” is entered into 30th of January 2018 between the Madha Dental College and Hospital represented by its **Principal** having address at Madha Dental College and Hospital, Chennai-69, (hereafter referred to as, ’the college’)

And **Dr. P. Jayavelu** aged 60 years working as professor and HOD at the College, having residence address at Maduravoyal, Chennai, Tamil Nadu (Herein after referred to as the ‘Principal Author’)

And **Dr. Divya Bharathi. M** aged 25 years currently studying as postgraduate student in Department of Oral and Maxillofacial Surgery in Madha Dental College and Hospital (Herein after referred to as the ‘PG/Research student and Co- Author’).

Whereas the ‘PG/Research student as part of his curriculum undertakes to research **" A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATION IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR, AN IN VIVO STUDY"** for which purpose the PG/Principal author shall act as principal author and the college shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-Author.

Whereas the parties, by this agreement have mutually agreed to the various issues including in particular the copyright and confidentiality issues that arise in this regard.

Now this agreement witnessed as follows:

1. The parties agree that all the Research material and ownership therein shall become the vested right of the college, including in particular all the copyright in the literature including the study, research and all other related papers.

2. To the extent that the college has legal right to do go, shall grant to license or assign the copyright do vested with it for medical and/or commercial usage of interested persons/entities subject to a reasonable terms/conditions including royalty as deemed by the college.

3. All the parties shall share the royalty so received by the college equally.

4. The PG/Research student and PG/Principal Author shall under no circumstances deal with the copyright, Confidential information and know – how generated during the course of research/study in any manner whatsoever, while shall sole vest with the manner whatsoever and for any purpose without the express written consent of the college.

5. All expenses pertaining to the research shall be decided upon by the principal investigator/Co-Author or borne sole by the PG/research student (Co-Author).

6. The college shall provide all infrastructure and access facilities within and in other institutes to the extent possible. This includes patient interactions, introductory letters, recommendation letters and such other acts required in this regard.

7. The principal author shall suitably guide the student Research right from selection of the Research Topic and Area till its completion. However the selection and conduct of research, topic and area research by the student researcher under guidance from the principal author

shall be subject to the prior approval, recommendations and comments of the Ethical Committee of the college constituted for this purpose.

8. It is agreed that as regards other aspects not covered under this agreement, but which pertain to the research undertaken by the student Researcher, under guidance from the Principal author, the decision of the college shall be binding and final
9. If any dispute arises as to the matters related or connected to this agreement herein, it shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996.

In witness whereof the parties' hereinabove mentioned have on this the day month and year herein above mentioned set their hands to this agreement in the presence of the following two witnesses.

College represented by its

**Principal** **PG Student**

**Witnesses** **Student Guide**

1.

2.

# INSTITUTIONAL ETHICAL COMMITTEE

MADHA DENTAL COLLEGE AND HOSPITAL
KUNDRATHUR, CHENNAI-600072.
Telephone no: 044-24780736, *Email id:* madhadentalcollege@gmail.com
*Affiliated to The Tamil Nadu Dr. M.G.R. Medical University*
DCI Recognition No: Lr.No.F.No. V.12017/75/2006-DE Dated: 01.11.2011

**Ref. No.:** 001/MDC/IEC/2015: **Date:** 22.12.2015

**Title of the work:** A Comparison of the efficacy of Scalpel Versus Laser in Incision and its influence On postoperative complications in surgical removal of mandibular third molar.

**Principal Investigator:** Dr. M. Divya Bharathi
I year MDS

**Department:** Oral and Maxillofacial Surgery.

The request for an approval from the Institutional Ethical Committee (IEC) considered on the IEC meeting held on 14.09.2015 at the Principal's Chamber Madha Dental College and Hospital, Kundrathur, Chennai- 69 is granted subsequent to her modification letter dated 21.12.2015 and you are

***" Advised to proceed with the study"***

The Members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the Principal Investigator.

The principal investigator and their team are directed to adhere the guidelines given below:

1. You should get detailed informed consent from the patients/ participants and maintain confidentiality.
2. You should carry out the work without detrimental to regular activities as well as without extra expenditure to the Institution or Government.
3. You should inform the IEC in case of any change of study procedure, site and clearance.
4. You should not deviate from the area of work for which you have applied for ethical clearance.
5. You should inform the IEC immediately in case of any adverse events or serious adverse reactions. You should abide to the rules and regulations of the institution (s).
6. You should complete the work within the specific period and if any extension of time is required, you should apply for permission again and do the work.
7. You should submit the summary of the work to the ethical committee on completion of the work.
8. You should not claim your funds from the Institution while doing the work or on completion.
9. You should understand that the members of the IEC have the right to monitor the work with prior intimation.
10. Your work should be carried out under the direct supervision of your Guide/ Professor.

**Secretary**
Prof. Dr.M.C.Sainath, MDS;
Principal- Madha dental college and Hospital

**Chairman**
Prof. Dr. Gajendran, M.D;
Dean- Madha Medical college and Hospital

# ACKNOWLEDGEMENT

I **Dr. Divya Bharathi. M** express my sincere thanks to chairman **Dr. Lion. S. Peter** Managing Director **Mr. Ajay Ravendra Kumar and Mrs. Mercy Florence** of Madha Dental College and Hospital , Chennai for their constant support, help and encouragement during my post graduation to accomplish my academic carrier.

I offer with profound respect and immense gratitude my heartfelt thanks to **Prof. Dr. M.C. Sainath M.D.S**, **M.B.A, PGDCR.,** Madha Dental College and Hospital, for his constant encouragement and support throughout my endeavour during my post graduation period.

I am greatly indebted to **Prof. Dr. P. Jayavelu M.D.S, Professor and HOD**, Department of Oral & Maxillofacial Surgery, Madha Dental College and Hospital, Chennai for his astuste, conceptualization and teaching me the art of surgery during the period of my study. Words cannot express the contribution and relentless encouragement given by this humble and luminous soul, to whom I will be obliged forever.

I am very much grateful to **Prof. Dr. R. Riaz, M.D.S.,** Department of Oral & Maxillofacial Surgery for his unrestricted help, advice throughout the study period and for his valuable guidance, encouragement, lending me his precious time for the successful completion of this study and throughout m y post graduation period

I express my sincere thanks to **Dr. A.R. Tariq Salam, M.D.S,** Reader, Department of Oral and Maxillofacial Surgery, for his valuable guidance, encouragement, lending me his precious time for the successful completion of this study and throughout my post graduation period.

I express my sincere thanks to **Dr. Saravanan M.D.S** of Department of Oral and Maxillofacial Surgery, for his valuable guidance and encouragement, throughout my post graduation period.

I express my sincere thanks to **Prof. Dr. Selvakumar M.D.S Professor and HOD** and the staff members of Department of Periodontics for teaching the application of laser and for their constant encouragement throughout the study.

It gives me and immense pleasure to convey my gratitude to the chairman of the Ethical Committee and Review Board - **Dean Dr. Gajendran. MBBS, MD;** and **Medical Superintendent Dr. Thanikachalam, MS, MCH (Plastic);** Madha Medical College and Hospital for giving me permission and helping me with this study.

I dedicate my sincere thanks to **Rev. Father. Panner Selvam, Mr. and Mrs. SAM, Dr. A.R. Murugan** for their prayers and support throughout the study.

I dedicate this study to my parents **Mr. Mohan Kumar. R & Mrs. Shanthi. M, Ms. Susmidha. M** for their unconditional love & concern and for their moral support .

I would like to thank all my colleagues and juniors for their timely help & support in the preparation of this dissertation. Narrow border of language could never express my respect and gratitude to all the patients who co-operated with me for this study.

Last but not the least I would like to seek the blessings of the Almighty without whose grace this endeavour wouldn't have been possible.

**Place: Chennai** **Name: Dr. Divya Bharathi. M**

**Date:** **Signature:**

**TITLE: A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATION IN SURGICAL REMOVAL OF MANDIBULAR 3rd MOLAR , AN IN VIVO STUDY.**


## ABSTRACT

**Background :** In modern society the demand for the bloodless operative field , minimal swelling , scarring and much less or no post surgical pain is increasing in oral surgery. These factors increase patients fear towards the surgical removal of 3rd molar. Today the oral surgeon has various option for the surgical removal of 3rd molar, but minimal research is available to provide the comparison of the efficacy of laser and B.P blade in incision during surgical removal of third molar

**Aim of the study :** The aim of this study was to compare the efficacy of scalpel and laser in incision and its influence on post operative complication in surgical removal of mandibular 3rd molar using standard clinical parameters

**Materials and Methods:** A prospective, randomized in vivo study was conducted in the DEPARTMENT OF ORAL AND MAXILLOFACIAL SURGERY, MADHA DENTAL COLLEGE AND HOSPITAL, CHENNAI. Thirty healthy patients with bilateral impacted mandibular third molars were selected for this study. Patients were randomly divided into two groups namely group 1 and group 2. Scalpel incision and laser incision were used in group 1 and group 2 respectively. The influence of these incisions on ease of access, time required for surgery, post-operative mouth opening,

swelling, pain, wound healing, wound infection, dry socket parethesia and intra op bleeding was evaluated.

**Results:** The results of this study show significant difference with respect to accessibility to surgical site, time required for the surgery, intra operative bleeding, post-operative decrease in mouth opening, post-operative swelling and wound healing. Laser incision provided excellent access to the surgical site as compared to Scalpel incision . Time required for the surgery was least with the use of laser incision, while it was more with scalpel incision. Post-operative mouth opening, post-operative swelling and wound healing were affected more adversely with the use of Scalpel incision while these parameters were least adversely affected with the use of Laser incision. Significant differences were not noted with respect to post-operative pain, wound infection, dry socket and paresthesia.

**Conclusion:** Laser incision is more preferable when compared to Scalpel incision although it may require some practice initially and a more broader study group of patients under each category is recommended.

**Keywords:** Impaction, mandibular third molar, Scalpel incision, Laser incision, post-operative complications.

# ABBREVIATIONS

| | | |
|---|---|---|
| **M3** | : | Mandibular third molar |
| **FIG** | : | Figure |
| **VAS** | : | Visual Analogue Scale |
| **N** | : | Count |
| **P value** | : | Value of Significance |
| **ANOVA** | : | Analysis of Variance |
| **SD** | : | Standard Deviation |
| **LASER** | : | Light Amplification by Stimulated Emission of Radiation. |
| **Nd-YAG** | : | neodymium-doped Yttrium aluminium garnet |
| **HO:YAG** | : | Holmium:Yttrium aluminium garnet |
| **Er:YAG** | : | erbium-doped Ytrrium aluminium garnet |
| **GaAIAs** | : | Gallium-Aluminium-Arsenides |
| **LLLT** | : | Low Level Laser Therapy |
| **OPG** | : | Orthopantomogram |
| **CBCT** | : | Cone Beam Computed Tomography |
| **NSAIDs** | : | Non-Steroidal Anti-Inflammatory Drugs. |
| **ASA** | : | American Society of Anesthesiologist |
| **CFU** | : | Colony forming units |

# TABLE OF CONTENTS


| S.NO | TITLE | PAGE NO. |
|---|---|---|
| 1. | INTRODUCTION | 1 |
| 2. | AIM AND OBJECTIVES | 4 |
| 3. | REVIEW OF LITERATURE | 5 |
| 4. | MATERIALS AND METHODS | 31 |
| 5. | CASE REPORT | 46 |
| 6. | OBSERVATIONS AND RESULTS | 50 |
| 7. | DISCUSSION | 64 |
| 8. | SUMMARY AND CONCLUSION | 73 |
| 9. | BIBLIOGRAPHY | 75 |
| 10. | ANNEXURES | 88 |

# INTRODUCTION

Impacted tooth is defined as “A tooth which is completely or partially unerupted and is positioned against another tooth, bone or soft tissue so that its further eruption is unlikely, described according to its anatomic position”.[1] The most commonly impacted teeth are mandibular third molar. This accounts for almost 98% of all other impaction.[4] Maxillary and mandibular third molars are the most likely teeth to get impacted which is followed by maxillary canines, mandibular premolars, maxillary premolars, and second molars. Impaction of first molars or incisors is uncommon in both the arches.[2]

The eruption of lower third molar is generally complete at the mean average age range of 20 – 24 years. It has been proved that the position of retained third molar does not change substantially after 25 years.[5] The most common reason for the removal of impacted mandibular third molar after the chronological age is pericoronitis. The other cause of third molar are dental caries, orthodontic consideration, crowding of mandibular incisors, interference with orthognathic surgery, association with cyst and tumours, root resorption of adjacent tooth, prosthetic consideration, to prevent the occurrence of jaw fracture and chronic pain.[6]

The common contra indications for the removal of impacted teeth are advanced age, systemic complication, and it can cause damage to adjacent vital structures.[7] The most common local factors for the

permanent tooth impaction are the prolonged retention of deciduous tooth, improperly positioned tooth germs, arch length discrepancy, supernumerary tooth, cleft lip and palate. [8]

Surgical removal of impacted teeth is one of the most common procedures performed by oral and maxillofacial surgeons. It involves the manipulation of both hard and soft tissue that can cause several postoperative complications. Pain, swelling, trismus is the most commonest postoperative (post op) discomforts that affects post-operative quality of patient's life following the surgical removal of mandibular third molar. Therefore the post-operative complications should be reduced to improve the post operative quality of the life of the patient.[9]

Scalpel, electrocautery and laser system are commonly utilized as effective tool in soft tissue surgeries. The most common tool is scalpel. The main drawback of the scalpel is that they do not provide haemostasis, which is an important key factor in the highly vascularised region like oral cavity. Therefore, there arises a need for an alternative for the soft tissue surgeries.[10]

Laser is a monochromatic, collimated, coherent, and intense beam of light produced by stimulated emission of radiation of light source. Among the various lasers used in oral and maxillofacial surgery, the diode lasers had been proved compact, inexpensive,

portable, more efficient and reliable wavelength ranging between 805 – 910 nm[11].

The aim of the study was to compare the efficacy of scalpel and laser in incision during the surgical removal of mandibular 3rd molar using clinical parameters such as pain, swelling, intra operative bleeding, maximum interincisal mouth opening and healing to improve the post-operative quality of life to the patients.

# AIM AND OBJECTIVES

**Aim:**

To compare the efficacy of scalpel and laser in incision and its influence on post operative complications during surgical removal of mandibular third molar using clinical parameters

**Objectives of the study:**

To evaluate the following parameters -

1. Ease of access
2. Time required for surgery
3. Post-operative mouth opening
4. Post-operative swelling
5. Post-operative pain
6. Wound healing
7. Dry socket
8. Paresthesia
9. Intra operative bleeding
10. Wound infection

# REVIEW OF LITERATURE

## DEFINITION OF IMPACTION:

**Mead et al., [1954]** [1] has defined an impacted tooth as a tooth that is prevented from erupting into position because of, lack of space, or other impediments.

**Peterson [1998] et al.,** [2] characterized impacted teeth as those teeth that fails to erupt into the dental arch within the expected time.

**Farman [2004] et al.,** [3] wrote that impacted teeth are those teeth that prevented from eruption due to a physical barrier within the path of eruption.

## PREVALENCE OF THIRD MOLAR IMPACTION:

**Alling CC et al., [1993]**[13] in indications of management of third molar has stated that third molar eruption depends on the race, dietary habits, degree of usage of muscle of mastication and hereditary.

**Hattab FN et al., [1999]**[14] in the radiographic evaluation of the eruption of mandibular third molars in male is approximately 3 to 6 months before the females of same age.

**Elsey MJ et al., [2000]** [15] in a survey of development of third molars, it was found that it generally develops between the age of 17 – 21 years.

**Yuasa H et al., [2004]** [16] in clinical postoperative findings of third molar impaction stated that the incidence of third molar impaction is higher in females.

**Padhye MN et al., [2013]**[4] in a retrospective clinico-radiographic survey on pattern of third molar impaction in the Indian population, the most commonly impacted teeth are the mandibular third molar which accounts for almost 98% of other impactions.

**AETIOLOGY OF MANDIBULAR THIRD MOLAR IMPACTION:**

**Björk A et al., [1969]**[17] in his study found that there is an insufficient development of ramus due to the imbalance in the process of resorption and deposition at its anterior and posterior surface which can lead to lack of space for the third molar to develop.

**Richardson M et al., [1975]**[18] in his research on the development of third molar impaction found that it can also get impacted due to the reduced angulation of the mandible and increased mandibular plane angle.

**Grover PS et al., [1985]** [19] stated that one of the reason for the mandibular third molar getting impacted is the gradual reduction in the size of the maxilla and mandible due to evolutionary changes.

**Richardson M et al., [1992]** [20] in his study of changes in lower third molar position in the young adults stated that the eruption of mandibular third molars depends on their favourable path of eruption.

**Lytle JJ et al., [1995]**[21] in his paper on the etiology of third molar impaction pointed out that due to modernization of culture the food products have changed from hard to refined foods and sweet diet, there is decrease in the stimulation of growth of the jaw, hence the people of modern society has more impacted and unerupted teeth.

**Yamaoka M et al., [1997]** [22] compared the relationship between the impacted mandibular third molar and their root angulation and found that the third molar with greater root angulation gets more impacted than with the lesser ones.

**CLASSIFICATION OF IMPACTION:**

**Winter G [1926] et al.,** [23] has given the classification based on the inclination of third molar to the second molar long axis

- In Mesioangular third molar, there will be a mesial tilt towards the second molar
- In Distoangular third molar, there will be a tilt distally /posteriorly away from the second molar

- Vertical –third molar long axis is parallel to the long axis of the second molar
- Horizontal – third molar long axis is horizontal to the long axis of second molar.
- Buccal / lingual - along with above tilt, the tooth may be placed buccally towards the cheek or lingually towards the tongue.
- Transverse – horizontal impacted but in cheek-tongue direction is Inverse.

**Pell GJ GB et al., [1933]** [24] has given the classification based on relationship between the lower third molar and the ramus of the mandible.

**Position A** – The occlusal plane of the third molar is at the same plane or above the occlusal plane of second molar.

**Position B** - The occlusal plane of the third molar is below the occlusal plane but above the cervical margin of the second molar.

**Position C** - The occlusal plane of the third molar is below the cervical margin of the second molar.

**Class I** - The availability of the sufficient space from the distal portion of the second molar to the anterior border of the ascending part of the ramus for the lower third molar to erupt.

**Class II** – The availability of space between the distal aspect of the second molar and the anterior border of the ascending ramus is less than the mesiodistal width of the crown of the lower third molar.

**Class III** - There will be an absolute lack of space between the distal aspect of the second molar and the anterior border of the ascending ramus. The third molar will be completely embedded in bone.

There is a higher risk of damage of Inferior Alveolar Nerve injury and fracture of mandible.

**Peterson et al., [1998]** [2] has given the classification based on tissue covering of the impaction.

**Soft tissue** – The highest point of the tooth contour is above the level of the corresponding alveolar bone and covered only by the soft tissue easy to remove the tooth

**Hard tissue (bony)** - The impacted tooth fails to erupt due the overlying bone.

It subdivides into

i. Partial bony hard tissue impaction – the superficial part of the tooth is covered by overlying soft tissue while the highest point of the tooth contour is below the level of corresponding alveolar bone. Require the removal of surrounding bone.

ii. Completely bony hard tissue impaction - the tooth is completely covered by the bone. Tooth has to be sectioned and large amount of bone has to be removed.

**Quek SL et al., [2003]** [25] proposed the classifications for angulations of third molar(modification of Pell and Gregory's classification) to second molar by measuring using orthodontic protractor from the anterior border of the ramus of mandible to the distal surface of the second molar.

| | |
|---|---|
| Vertical | 0° to 10˚ |
| Mesioangular | 11˚ to 79 |
| Horizontal | 80° to 100 |
| Distoangular | 11° to 79° |
| Other | 111°to 180 |

**Classification for depth of mandibular molar:**

Level A - Not covered by bone

Level B - Partially covered above the level of cementoenamel junction

Level C - Completely covered by bone.

## VARIOUS INDEX TO ASSESS THE DIFFICULTY DURING THE SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR:

**Sanjeev Kumar et al., [2014]** [26] reviewed the method of assessment of the depth and difficulty of extracting impacted mandibular wisdom molars by WAR line (winters line). The WAR lines are interpreted as each mm increase in the redline can increase the difficulty index by three times. Nevertheless, these are of only historical value.

**Mac gregor et al., [1985]** [27] has given the WHARFE'S assessment to assess the difficulty in surgical removal of impaction.

**Chiapasco M et al., [1993]** [28] has given a classification on the post operative assessment of difficulty in surgical extraction

Criteria of modified Parant scale.

**Easy I** Extraction requiring forceps only

**Easy II** Extraction requiring osteotomy

**Easy III** Extraction requiring osteotomy and coronal section

**Easy IV** Complex extraction (roots section)

**PEDERSON et al., [2003]** [29] proposed a difficulty index based on the anatomy and radiographic features including angulation, depth and ramus relationship. However these difficulty index are not used frequently in clinical practice because of the incorrect result of difficulty index.

**Diniz-Freitas et al., [2007][30]** in his article has proved that Pederson difficulty index has failed to predict true difficult rate of removal of impacted third molar.

**Kharma MY et al., [2014] [31]** in his paper mentioned that the main difference from Pederson difficulty index is the inclusion of the root form which is an important predictor of surgical difficulty.

**Spatial relationship**

| | |
|---|---|
| Mesioangular | 0 |
| Horizontal/transverse | 1 |
| Vertical | 2 |
| Distoangular | 3 |

**Depth**

| | |
|---|---|
| Level A: High occlusal level | 1 |
| Level B: Medium occlusal level | 2 |
| Level C: Deep occlusal level | 3 |

**Ramus relationship/space available**

| | |
|---|---|
| Class 1: Sufficient space | 0 |
| Class 2: Reduced space | 1 |
| Class 3: No space | 2 |

**Root form**

| | |
|---|---|
| Convergent | 0 |
| Divergent | 1 |
| Bulbous | 2 |

**Difficulty index**

| | |
|---|---|
| Very difficult | 7-10 |
| Moderately difficult | 5-7 |
| Slightly difficult | 3-4 |
| Easy | 1-2 |

**Radiological assessment of Mandibular third molar impaction and extraction:**

**Bishara SE et al., [1983]** [32] in his review article on third molar stated that in the region which are exceeding the coverage of periapical radiograph, panoramic radiograph can be the method of choice. The advantages of OPG are the entire structures of upper and lower jaw can be visualized in a single radiograph with reduced radiation and fairly in expensive.

**Denio d et al., [1992]**[33] in his study has stated that periapical radiographs are the most common radiographic technique used for the assessment of third molar. Long cone paralleling technique is the technique of choice due to its use of reduced dose, magnification and relatively accurate relationship of third molar with bone and adjacent tooth structure is produced.

**Flygare L et al., [2008]** [34] in his paper compared the various pre operative radiographic techniques and concluded that traditional panoramic and or intra oral radiographs are sufficient as imaging technique in vast majority of cases. Remaining cases mostly can be solved by posteroanterior open mouth projection.

**Ghaeminia H et al., [2011]** [35] in his prospective study evaluated the role of CBCT in the assessment of difficulty in third molar extraction and found that it was helpful in assessing the risk of inferior alveolar nerve injury.

**Matzen LH et al., [2012]**[36] in his study has confirmed that CBCT were useful in 12% of cases in which there was a direct contact with nerve either by narrowing , grooving or bending of canal in relationship to root complex.

**Juodzbalys G et al., [2013]** [37] proposed a new classification for extraction difficulty degree based on anatomical and radiological findings relationship to the adjacent anatomical structures, second molar, alveolar crest, mandibular canal , ramus, position of the tooth. This classification was clinically reliable.

**INDICATIONS OF SURGICAL REMOVAL OF THIRD MOLAR**:

**NIH [National Institute of Health 1979]**[38] has recommended the following conditions for the removal of both impacted and erupted mandibular third molar.

- Follicular enlargement
- Pericoronitis
- Third molar with non-restorable caries
- Root resorption of second molar.

**Koerner KR et al., [1994]** [39] has given the following indications in his review article on the principle and procedure of removal of impacted third molars.

- Existing pathology like abscess, cyst, or neoplasm
- Pericoronitis pain due to inflammed flap
- Periodontal condition of second molar and third molar
- Resorption of adjacent roots
- Abnormal position of impacted tooth either buccally or lingually.
- Hinderance for prosthetic rehabilitation.

**Lytle JJ et al., [1995]**[21] in his paper on the indication of impacted teeth has added few more points like infected impacted teeth, periodontally compromised third molar, damage of adjacent teeth, crowding of the mandibular anterior teeth, cyst and tumours

corresponding to the impacted tooth before radiotherapy, for prosthodontics rehabilitation and facial pain.

**The National Institute of Clinical Excellence (NICE) of England guidance for wisdom tooth removal [2003][40]**

- For third molar associated with pathology
- Untreatable caries
- Periodontal condition of third molar
- Associated pulpal and/or periapical diseases
- Osteomyelitis, cellulitis, and abscess
- Both internal and external resorption of adjacent tooth
- Impacted tooth fracture
- Presence of follicular enlargement
- Recurrent pericoronitis
- When present within the region of tumour resection.

**Other indications for removal**:

- To be used in autogenous tooth transplantation
- Prophylactic removal in medically compromised conditions where complication of retaining tooth overweighs the risk of removal
- To avoid the confusion with the facial pain caused by the temporomandibular joint and muscle dysfunction
- Presence of partial or unerupted third molar close to the planned area of prosthetic rehabilitation

- Patients who are inaccessible to dental care
- When the eruption second molar is been hindered by the presence of third molar
- In the line of resection of orthognathic surgery
- When the general anesthesia has been administered for removal of one of the third molar simultaneously the rest of the third molar, whose retention overweighs the complication of removal can be removed.

**DIFFERENT FLAP DESIGN IN MANDIBULAR THIRD MOLAR SURGERY:**

**Kruger G et al., [1969]**[41] – proposed an modification of vertical flap called vertical thoma's flap by making an horizontal incision brought in contact with distal surface of the distobuccal cusp of mandibular second molar.

**Thoma K H et al., [1969]** [42] has explained about the "vertical flap" which can be used for the complete soft tissue impaction in which the anterior limb extends over the alveolar ridge and down on the buccal side and posterior limb runs from lingual side to the retromolar area about 2mm behind the second molar.

**Geoffrey Howe et al., [1985]** [43] **observed** that Ward's and modified Ward's incision provided excellent visual and mechanical access and can be closed by means of suture inserted between buccal and lingual

soft tissues alone. This avoids the need for an additional suture in the buccal sulcus, a procedure which at times gives rise to considerable difficulty.

**Mac Gregor AJ et al., [1985]**[44 ] stated that Novitsky in 1980 was the first one to raise the flap and to do bone removal and Steel 1895 was the first one who attempted to split the gums surrounding third molar and removed using sharp drills.

**Alling CC et al., [1993]** [13] the incisions used to expose impacted mandibular third molars that have been described in textbooks and various studies can be broadly grouped under Triangular and envelope types. Regardless of variations in the anterior end of the incisions, all extend posterior limb from the distal aspect of the preceding second molar towards the ascending ramus. The length and angulation of this extension depends on the position of the third molar and to the proximity and lateral flare of the ramus.

**Peterson LJ et al., [2003]**[29] It has been stated that though envelope flap is widely used, a releasing Incision is made to gain wider access to remove a deeply placed impacted tooth, as the envelope flap may not provide adequate access. However the envelope flap usually is associated with fewer complications and tends to heal more rapidly with less pain than the three cornered flap and when a releasing

incision is made, a small buccal artery is sometimes encountered and this may be mildly bothersome during the early portion of surgery.

**Post operative complications:**

**J. Savin, G. R. Ogden et al., [1997]** [45] prepared a preliminary report on aspects affecting quality of life in the early postoperative period after third molar surgery. Results showed that within the first postoperative week some patients could experience deterioration in their quality of life, that extends beyond the traditionally recognized side effects and which shows little improvement in the first postoperative week.

**McGrath et al., [2003]** [46] has conducted a study on to assess the changes in quality of life following third molar surgery in the immediate postoperative period. He found that the quality of life measures identified a significant deterioration in quality of life and this remained evident on1$^{st}$, 2$^{nd}$, 3$^{rd}$ 4$^{th}$ and 5$^{th}$ postoperative days. Deterioration in quality of life over the study period was associated with swelling and trismus.

**Hawkins D et al., [2005]** [47] has evaluated the response of Low Level Laser Therapy (LLLT) on intra oral soft tissue on proved it to be effective in wound healing.

**Aras MH et al., [2009]** [48] [49] has reviewed the literature on post surgical management of pain and inflammation after surgical removal third molar and has got many evidence that LLLT can be used as an adjuvant to improve the post operative quality of patient.

**Negreiros RM et al., [2012]**[50] performed an interventional prosp ective study of 86 patients and decided that there was a higher oral health impact profile score and lower oral health related quality of life have been recorded after surgical removal of impacted third molar in comparison with non impacted third molars.

**G.Gasperini et al., [2014]**[51]found in their randomized, crossover, double-blind clinical trial that LLLT application post operatively for a period of one month has decreased pain and swelling resulting from orthognathic surgery.

**Farnaz Falaki et al., [2014]** [52] has reviewed the literature from 1986 to 2011 and he concluded that LLLT can be used a modality to reduce the pain in patients with neuralgia who are tolerant to drug therapy.

**Landucci A et al., [2015]** [53] has conducted a randomized clinical trial on 22 patients to compare the efficacy single dose of LLLT (780nm) for the reduction of pain, swelling and trismus after surgical removal of mandibular molars bilaterally. He concluded that there was higher reduction in the postoperative complication followed by surgery.

**Kim K, Marta Lopez et al.,** [54][55] Multiple methods have been used to improve the quality of life after surgical removal of third molar such as administration of local or systemic corticosteroids , NSAIDS, modification of incisions and laser therapy.

**Lasers in oral and maxillofacial surgery:**

**Pecaro et al., [1983]** [56] studied 40 cases using diode lasers and stated the advantages of laser over scalpel are relatively bloodless surgical field, reduced swelling, scarring, pain, time taken to perform the procedure. There will not be an need for suturing .Instant disinfection of the surgical wound. Laser can also be used in non-contacting mode, thereby reducing the mechanical trauma.

**Fisher SE et al., [1984]** [57] in his study on effect of the laser on oral tissues and found that there will be a decreased post op swelling after laser use.

**Basu M K et al., 1988**[58] did his histological study on soft tissue healing after incision with laser and scalpel. He observed that the healing starts from the periphery of the epithelium at the end of two week, which is parakeratotic and thin when compared to the epithelial healing after incision with scalpel. This in turn will lead to excellent esthetic outcome with no fibrous scarring. However in the post operative healing after the incision with scalpel, it left small residual

defect in five out of the twenty five cases treated for mucocele of lower lip

**Roodenburg JL et al., [1990]**[59][60] in his comparative histological study on rats on wound healing found that tissue scarring are better when compared to scalpel incision. This difference in scarring is due to a production of decreased lateral tissue damage, less traumatic surgery, depth of tissue damage is controlled, and formation of less myofibroblasts in laser wounds compared with scalpel wounds. Laser wound heals with minimal scar formation . Because of this improved healing and hemostasis, intraoral laser wounds can often be left without suturing except when cosmesis is an issue.

**Kaminer R et al., [1990]**[61]in his research paper on bacteraemia following laser and conventional surgery found that post operative bacteraemia has been found to highly reduced with the use of laser by sealing of the blood vessel and lymphatics when compared with scapel.

**Shuller DE et al., [1990]** [62] in his review article has briefly explained intra cellular changes while using diode laser in oral cavity. He found that there will be a reduced local pain, oedema and requirement of local anaesthesia due to cicatrix formation.

**Pick RM et al., [1993]**[12] in his review paper stated that the advantage of diode laser over scalpel surgical procedures are greater precision ,

bloodless operative field and in post surgical course, sterilization of the surgical field, reduced swelling , scarring , enhaced coagulation , vaporization , cutting efficiency .reduced number or no suturing requires. Decreased or no post surgical pain.

**Gaspar L et al., [1994]**[63] in his review paper on the use of lasers in oral surgery stated that the advent of laser into oral and maxillofacial has begun since 1960.

**Strauss R et al., [1997]**[64] in his review paper on applications of lasers in oral and maxillofacial surgery stated that "Laser are most commonly used in omfs essentially as a light scalpel to make incison which would be more thin , relatively deep when compared to incision made with scalpel blade.

**Guy A et al., [ 1997]**[65] has stated in his text book about the advantage of diode laser over Nd – YAG laser device is diode lasers works on continuous steady mode with constant energy delivered to tissue as a result more control output power than pulsed mode of Nd – YAG. Comparatively there will be a reduced risk of adjacent vital structures like nerve, vessels, teeth while using diode laser.

**Romanos G et al., [1999]** [66] in his research, paper based on the clinical applications of diode laser found that the incision margin of diode laser is precise when compared with the $Co_2$ and Nd: YAG lasers.

**George romanos D.D.S et al., [1999]** [67] in his randomized control trial on 22 patients with different oral indications were operated using diode laser of wavelength of 980nm. The results showed that they were reduced post op pain even when no medications were used to relieve pain, no post op bleeding, significantly reduced swelling, enhanced wound healing without any scar formation or functional disturbance, while comparing with other laser system, the incision using diode laser were more precise.

**Zeinoun et al., [2001]** [68] did animal study on 144 rats and compared the histologic features of laser, scapel and electrocautery post op wound healing. He concluded that laser wound contains relative lower number of myofibroblasts, which is the main factor responsible for contraction of wound and scarring. Lasers improves post quality of life of patients particularly when used intra orally.

**Kreisler M et al., [2002]** [69] has done randomised control trial on fifty patients comparing the efficacy of Nd: YAG, Ho: YAG, Er: YAG, CO2, and GaAIAs laser irradiation on implants. The results stated the diode laser offers bactericidal effect.

**Robert A Strassus et al., [2004]** [70] Lasers are used in excision of benign and malignant lesions, vascular lesions, preprosthetic surgery and for patients with bleeding disorders. Among various lasers used in oral surgery, the diode lasers are proved compact, inexpensive,

portable, more efficient, and reliable. Wavelength of diode lasers range between 805nm – 980nm.

**Camillo D'Arcangelo et al., [2007][10] -** did an preliminary study to compare wound healing of diode laser with scalpel . After the immunohistochemical, analysis with nitric oxide synthase isoforms (eNOS and iNOS) found that even tough traditional scalpel allows an incision without loss of tissue; lasers are able to provide a good healing, excellent ability of incision and good bleeding control.

**Convissar RA et al., [2010] [**[71] in his textbook on principles and practices of laser dentistry has coated that the diode laser becomes very popular recently as they exhibit antibactericidal effect and enhances wound healing.

**D. Yazicioglu et al., [2010]**[72] conducted a study on 42 male wistar albino rats to compare the efficacy of scalpel, electrocautery and diode laser on wound healing in diabetic and he found that diode laser was superior in haemostatic capabilities on diabetes and anticoagulant properties.

**Suter VG et al., [2010]** [73] in his research article found that laser induced wound healing was with minimal degree of wound contraction and no scar formation compared to scalpel.

**Shalawe WS et al., [2012]** [74] conducted a study on thirty patients to clinically compare the efficacy of diode laser and scalpel incision in soft tissue. The diode laser had a wavelength of 1064nm with output power of 3.5 watt continuous wave. He concluded that diode laser has several advantages over scalpel, which includes minimal requirement of local anaesthesia, elimination of the need of suture, reduced postoperative pain, and edema.

**Akbulut N et al., [2013]** [75] in his original article treated 27 patients with benign oral soft tissue lesions using diode laser (810nm). The results were no incidence of infection, no suturing required. Patients were comfortable, experience no pain both intra, and post operatively.

**Azma E et al., [2013]**[76] in her study on application of diode laser in oral surgery stated that The advantages of oral-laser surgery include an great visibility in field, precision, enhanced infection control and elimination of bacteraemia, quite bloodless surgical and postsurgical period, minimum swelling and scarring, reduced postsurgical pain, minimal administration of anaesthetics shots. This will reduce the time spent in dental chair.

**Ehsan Azma et al., [2013]**[77] has conducted an study on application of diode lasers in soft tissue of oral cavity .In his article he stated that Diode lasers has unique specialities of creating sharp and definite cutting edge , Haemostasis both during and after the surgery , more

compatible. Diode laser are very and a useful alternative device in surgery related to soft tissue of oral cavity in comparison to laser and scalpel.

**Pai JB et al., [2014]**[78] on his randomized control trial on 50 patients with fibroma stated that use of more compact diode laser reduced the fear of the patient rather than sight of scalpel and makes the patients more comfortable.

**Mazarei Sotoode et al., [2015 ]**[79] conducted research on the series of case with different benign exophytic lesions to test the efficacy of diode laser in oral surgery and found that these lasers makes both the surgeon and patient comfortable by reducing the operating time by providing bloodless operative field.

**M.B.F. Amaral et al., [2015]** [80] in his randomized control trial consisting 35 patients, he compared the effects of diode laser surgery to those of the conventional technique in patients with fibrous hyperplasia. On comparison significant difference were observed in the duration of the surgery and the use of the analgesic medication. However, the postoperative wound healing was significantly faster in scalpel group as compared to the laser group.

**Huang IY, Kopp WK, Frame JW, España AJ, Bornstein MM et al.,** [81, 82, 83, 84, 85] in their research study on comparison between laser and scalpel on oral soft tissue has concluded the advantages of lasers are

- Simple and rapid
- No intra op and post op bleeding
- Decrease in the time taken to complete procedure
- Reduced post op paraesthesia and other complications
- Decreased rate of relapse
- Avoidance of suturing which can damage to adjacent structure
- Reduced pain, post operative swelling and bactericidal effect.

**Karu T, Smith K, Harris DM, Elanchezhiyan S, Asnaashari M et al.,** [86, 87.88, 89, 90] has conducted multiple animal and human study on healing of laser wounds and stated that the principle of laser will cause biomodulation of cells .This can alter cellular behaviour by interacting with mitochondria and calcium channels .This interaction enhances cellular metabolism and proliferation ,which in turn leads to increased coagulation ability and peculiar healing mechanism different from scapel.

**U. S. Pal et al., [2013]**[91] has proposed an index for soft tissue wound healing based on tissue colour, response to palpation, presence of granulation tissue and suppuration.

**Schorn MN et al., [2016]**[92] has conducted an clinical experiment using aspirated blood to find the most reliable method of assessment of

bleeding . He concluded the experiment by emphasising the accuracy of visual analog scale to measure the blood loss estimation.

**A. B. Bataineh et al., [2013]**[93] has proposed a method for postoperative assessment for paraesthesia which was done after one week at the time of suture removal by by testing about lip, chin, and tongue sensibility and performing 2-point discrimination neurosensory test.

**Clauser C et al., [2016]**[94] compared the various method of assessment of pain after the surgical removal of third molar . He concluded from his statistical report that the visual analog scale is the most reliable method to measure the postoperative pain.

**Mahitab Mahmoud Soliman et al., [2014]** [96] conducted a study on 50 patients to compare treatment modalities of surgical flap incision for the removal of partially impacted mandibular third molar using scalpel and laser. He concluded that the diode laser as a modern therapeutic method proved to be a simple, elegant, and clean way for surgery without bleeding. It is far gentler than scalpel surgery; unlike electro surgery, lasers do not require the placement of a grounding plate. Tissue separates gently and easily with the laser, hemostasis is achieved rapidly, and there was minimal post-operative swelling. Diode Laser was being well tolerated by the patients and it is more successful than conventional treatment methods. Diode Laser demonstrated a significant fast healing of soft tissue and decrease bacterial growth

degrees and counts of CFUs/ml which in reduced the formation of dry socket.

**Roynesdal AK et al., [1993]**[97] has conducted a double blind cross over study to compare the efficacy of soft tissue laser on post operative pain, swelling and trismus followed by surgical removal of third molar. From his staitstical report he found that there is no significant difference between the study group and the control group.

# MATERIALS METHODS

## SELECTION OF PATIENTS

The present study was undertaken at the Department of Oral and Maxillofacial Surgery, Madha Dental College & Hospital; Chennai, after obtaining approval from the Institutional Ethics Committee (IEC). A total of 30 patients divided into 2 groups; both male and female, aged between 18 and 45 years, who had impacted mandibular third molars were randomly selected for this study.

## INCLUSION CRITERIA

1. Patients willing for voluntary participation and have signed informed consent.
2. Age group of 18-45 years
3. Both males and females
4. Patients with bilateral impacted mandibular third molars
5. ASA Grade 1 patients

## EXCLUSION CRITERIA

a. Infected impacted third molars
b. Immuno-compromised patients
c. Medically compromised patients
d. Pregnancy and lactating mothers
e. Patients allergic to amide and ester type of local anesthetics
f. Patients with traumatic injuries

**SAMPLE SIZE: 30**

**GROUP 1**: Standard Ward's incision with No.15 scalpel in 30 patients

**GROUP 2**: Standard Ward's incision with Diode laser in 30 patients

**STUDY DESIGN**

Ethical clearance was obtained from the Institutional ethics committee and the ethical principles were followed throughout the course of the study. Subjects for the study were selected randomly, if they fall under the inclusion criteria with no discrimination of sex, caste, religion or socio-economic status. After explaining the study procedure in their regional language, written informed consent was obtained in English from all the subjects selected for the study. Examination was preceded by a thorough medical and dental history of the patients.

**STUDY PROTOCOL**

- Obtaining medical history and informed consent
- Complete clinical examination by using diagnostic instrument set
- Extra-oral and intra-oral examination
- Pre-operative radiographic evaluation of selected region IOPA & OPG
- Pre-surgical preparation, Pre op assesments
- Surgical procedure
- Post-operative care
- Post-operative review, Post op assesments

- Clinical re-evaluation on 1st post-operative day, 3rd post operative day, 7th post-operative day, after 2 weeks, after 1 month and 2 month.

**ARMAMENTARIUM**

- Diagnostic instrument set
- Protective goggles for surgeon and patient
- Chlorhexidine mouth wash
- Normal saline
- Local anesthesia ( 2% xylocaine with adrenaline)
- Povidone iodine solution
- Impaction kit
- Wooden spatula
- Micromotor
- Ruler, divider
- Surgical straight hand piece and stainless steel 703 bur
- Sterile bowl
- Suture material: 3-0 Black Braided Silk
- Diode Laser Unit (800- 990nm, 7Watts)

## SURGICAL PROCEDURE

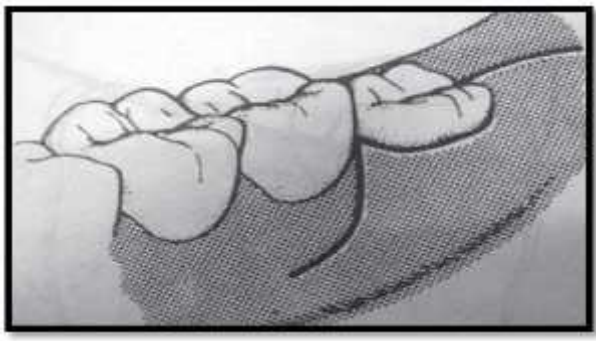
### Transalveolar extraction of mandibular third molars

The procedure was performed with proper aseptic precautions. A single operator carried out all the procedures.

All the patients were advised chlorhexidine mouthwash(0.12%) for oral rinsing (2 minutes) before the procedure. Standard scrubbing and painting procedures were done with 5% betadine. Standard draping procedures were followed.

Intra orally inferior alveolar nerve block was given along with lingual and buccal nerve is anesthetised using 2% Lignocaine with adrenaline 1:80,000.

**GROUP 1:** A standard Ward's/ modified ward's incision was placed using No.15 scalpel distal to second molar continued over the alveolar crest (if the tooth is completely embedded)/ along the buccal gingival sulcus of third molar, up to the distal aspect. Distal releasing incision is started from the distal most point of the third molar across the external oblique ridge into the buccal mucosa. Anteriorly the incision was extended upto the distal aspect of the second molar.



**WARD'S INCISION**

**GROUP 2 :** A standard Ward's / modified ward's incision was placed using The CLEAN CUT™, CLASS 4 LASER PRODUCT. This type of soft tissue diode laser, has one fiber optic cable that is threaded through a handle and used with the different operating tips. After each use, the used tip is discarded and new end is used for the next patient. Biolase requires no water or air connections and can be easily transferred between operatory. This particular diode laser works within a wavelength of 800-990nm with maximum power output of 7Watts. The power mode can be either continuous or pulse modulation. Commonly available fiber tips diameter sizes are 200µm, 300µm & 400µm with the pulse duration of 0.01ms-20ms having focal Spot size of 400µm (maximum in contact mode). Patient and Operating staffs wore special diode laser protective eye glasses. Highly reflective instruments or instruments with mirrored surfaces were avoided as there could be reflection of the laser beam.

**Surgical procedure**

A full thickness mucoperiosteal flap was raised and the crown of third molar was exposed. With the help of a micro motor, straight hand piece and using 703 bur sufficient bone guttering was done on the mesial, buccal and distal aspects of the tooth with copious saline irrigation. The tooth was elevated and lifted from the socket. In some patients the tooth was sectioned and retrieved in piece meal technique. The socket was carefully examined for remnants of tissue and then the

follicular tissue if present was curetted out from the socket. Bony edges were trimmed and smoothened by using bone file. The socket was irrigated with saline and betadine solution. The wound was closed primarily with 3–0' black braided silk after obtaining adequate haemostasis.

Patients were prescribed antibiotic course commencing 1 day before surgery to be continued post-operatively for 3 days.

**Postoperative Instructions**

All the patients were given routine post-operative instructions. They were given Capsule Amoxicillin 500 mg thrice daily,
Tablet Metronidazole 400 mg Thrice daily, Tablet Ibuprofen 400 mg Twice daily after the food and Tablet Ranitidine 150 mg thrice daily for 3 days half an hour before food.

**Follow Up Observation**

All the patients were evaluated:

- One day prior to the surgery
- First postoperative day
- Third day postoperatively
- Seventh day postoperatively
- Two weeks postoperatively
- One month postoperatively
- Two month postoperatively

**METHOD OF ASSESSMENT** :

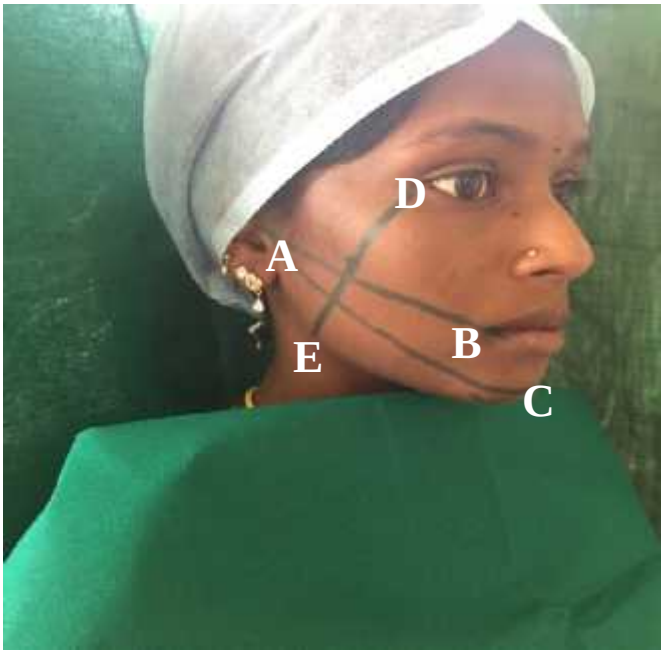
1. The influence of incision with scalpel and laser on visibility and accessibility during the surgical removal of impacted third molar was assessed based on the decision of surgeon intra operatively. The score was given as 0-poor, 1-moderate, 2-excellent.[29]
2. The time required for surgery was measured intra-operatively using standardized same digital chronometer for all the cases from the beginning of the incision placement until the final suture for closure by the second observer.
3. Mouth opening was measured pre-operatively and post-operatively with inter-incisal distance using scale and divider as the percentage decrease in mouth opening one day prior to the surgery, 1st , 3rd, 7th day, 2 weeks, one month and two months post operatively[53].

$$\text{Percentage decrease in mouth opening} = \frac{\text{(Preoperative measurement- Postoperative measurement)}}{\text{Preoperative measurement}} \times 100$$

**INTERINCISAL DISTANCE**

4. Pre-operative facial measurements were taken between centre of tragus to corner of mouth, centre of tragus to soft tissue pogonion and lateral canthus of the eye to angle of mandible. Post-operative facial swelling was measured as percentage increase in these facial measurements one day prior to the surgery, 1st , 3rd, 7th day, 2 weeks, one month and two months post operatively[53].

$$\text{Percentage increase in facial swelling} = \frac{(\text{Postoperative measurement} - \text{Preoperative measurement})}{\text{Postoperative measurement}} \times 100$$




A – Centre of tragus

B – Corner of mouth

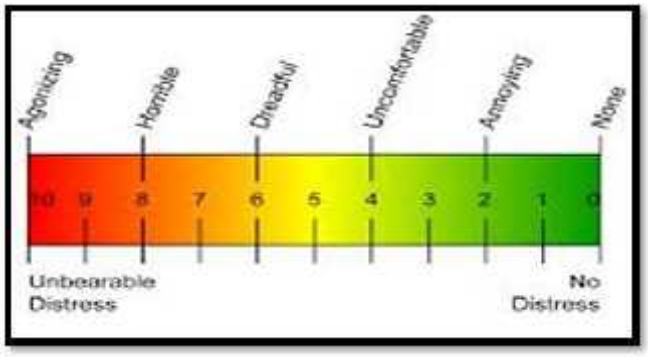
C – Soft tissue pogonion

D – Lateral canthus of eye

E – Angle of mandible

**POINTS FOR FACIAL MEASUREMENT**

5. The level of pain one day prior to the surgery, 1st , 3rd, 7th day, 2 weeks, one month and two months post operatively was assessed using a visual analogue scale (VAS), where 0 = no pain and 10 = worst pain imaginable.[53]




(6) Post operative wound healing was assessed based on Assessment of soft tissue healing index by Landry, Turnbell and Howley.[92]

**Healing index 1- Very poor ;**

Has two or more of the following:

(1) Tissue colour: >= 50% of gingiva red

(2) Response to palpation: Bleeding

(3) Granulation tissue: Present

(4) Incision margin: Not epithelialised, with loss of epithelium beyond incision margin

(5) Suppuration: Present.

**Healing index 2- Poor ;**

(1) Tissue colour: >= 50% of gingiva red

(2) Response to palpation: Bleeding

(3) Granulation tissue: Present

(4) Incision margin: Not epithelialised, with connective tissue exposed.

**Healing index 3- Good**

(1)Tissue colour: >= 25 %and <50% of gingiva red

(2)Response to palpation : No bleeding

(3)Granulation tissue: None

(4)Incision margin: No connective tissue exposed.

**Healing index 4- Very good**

(1) Tissue colour: <25% of gingiva red

(2) Response to palpation: No bleeding

(3) Granulation tissue: None

(4) Incision margin: No connective tissue exposed.

**Healing index 5- Excellent**

(1) Tissue colour: All tissues pink

(2) Response to palpation: No bleeding

(3) Granulation tissue: None

(4) Incision margin: No connective tissue expose

(7) Post operative dry socket was assessed using dry socket healing index given by U. S. Pal et al.

0 – No healing, No clot formation

0.5 – Clot formed/seen

1 – Clot stabilized

1.5 – 1/2 of socket epithelialized and covered

2 – 2/3 of socket epithelialized and covered

2.5 – Epithelialization almost complete, wound closed

3 – Socket appears closed with normal mucosa coverage.

The scoring 0, 0.5, 1, 1.5, 2, 2.5 are considered to be present and the patient who gets the scoring of 3 was considered to be absent.[91]

8. **Paresthesia** followed by surgical removal of mandibular third molar was assessed by pin prick test. In this test, a blent dental probe was applied to the skin in a quick pricking movement and pain perception of the patient was assessed. Each test area was pricked three times bilaterally, and subject was asked if any difference was felt between the sides. Sensation was checked by pricking tongue, mucosa, lip, and skin over chin Region. Paresthesia was defined as any postoperative change in sensitivity of tissues innervated by the trigeminal nerve after test evaluation. The scoring was given as either present or absent of sensation.[93]

**PIN PRICK TEST**

9. **Intra operative bleeding** during the procedures was assessed based on the presence or absence of bleeding.[80]

10. **Wound infection** was assessed based on the presence or absence of local exudates from the surgical site.[80].

**FIG 1: ARMAMENTARIUM**

**FIG 2: DIODE LASER UNIT**

## STEPS IN SURGICAL PROCEDURE

**STEP 1: INJECTION OF LOCAL ANESTHESIA**

**STEP 2A : SCALPEL INCISION**

**(GROUP 1)**

**STEP 3 A : MUCOPERIOSTEAL**

**FLAP ELEVATION (GROUP 1)**

**STEP 2 B: LASER INCISION**

**(GROUP 2)**

**STEP 3 B : MUCOPERIOSTEAL**

**FLAP ELEVATION (GROUP 2)**

**STEP 4: BONE GUTTERING USING**

**MICROMOTOR AND HANDPIECE**

**STEP 5 – POST EXTRACTION SOCKET**

**STEP 6 A: CL0SURE (GROUP 1)**

**STEP 6 B: CLOSURE (GROUP 2)**

# CASE REPORT

Name : Ms. Nandhini

Age/Sex : 23 Years/ Female

Chief Complaint : Patients complaints of pain in her right and left lower back tooth region for the past 1 week.

History of Presenting Illness: Patient gives the history of pain which is continuous and intermittent in nature for the past 1 week aggravated during mastication.

Past Medical History : No relavant history

Past Surgical History : No relavant history

Past Dental History : No relavant history

**GENERAL EXAMINATION:**

- Patient is moderately built and nourished
- Patient is conscious, alert, oriented
- No signs of pallor, icterus, cyanosis, clubbing, edema and regional lymphadenopathy

**LOCAL EXAMINATION:**

**INTRA-ORAL EXAMINATION** :

1) Mouth opening- 50 mm( inter incisal distance)
2) Impacted- 38, 48

**INVESTIGATION**: Orthopantomogram (OPG)

**DIAGNOSIS** : Impaction 38, 48 (Distoangular)

**TREATMENT PLAN** :

- Surgical removal of **38 under local anesthesia using Ward's incision with scalpel**
- Surgical removal of **48 under local anesthesia using Ward's incision with LASER**

**TREATMENT DONE:**

Surgical removal of **38 done under local anesthesia using Ward's incision with scalpel.** After 21 days surgical removal of **48 done under local anesthesia using Ward's incision with LASER**

**Pre Op Frontal View** **Intra Oral View**

**OPG**

## GROUP 1

**Scalpel Incision**

**Scalpel Closure**

**Scalpel Wound Healing**

**(GROUP 2)**

**Patient With Protective Goggles**

**Laser Incision**

**Laser Wound Closure**

**Laser Wound Healing**

# OBSERVATION AND RESULTS

The values are tabulated and are subjected to statistical analysis.

**TABLE 1 - AGE & SEX DISTRIBUTION**

| Group | Patients (n) | Male (n) | Female (n) | Mean age (yrs) |
|---|---|---|---|---|
| **GROUP 1** | 30 | 13 | 17 | 27.40 |
| **GROUP 2** | 30 | 13 | 17 | 27.40 |

**1. Ease of access** in 30 patients of group 1 was moderate in 6(20) % and excellent in 24(80) %. In-group 2 it was excellent in 30(100) %. The observations are tabulated in **table 2** and graphically represented in **graph 1.**

**GRAPH 1: EASE OF ACCESS**

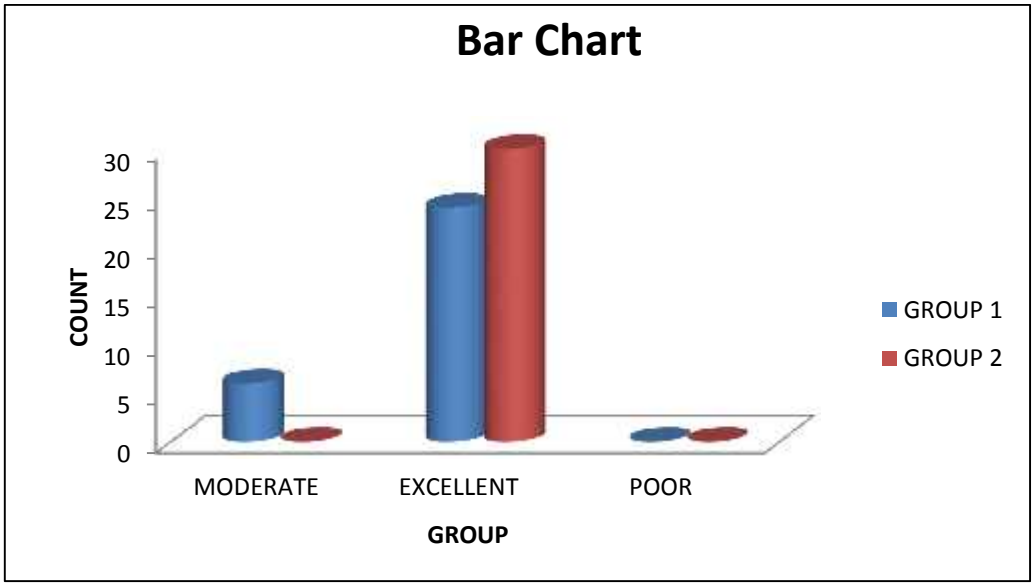


**TABLE 2 -EASE OF ACCESS**

| Group | | Ease of access | | | Total | P value |
|---|---|---|---|---|---|---|
| | | Moderate | Excellent | Poor | | |
| GROUP 1 | COUNT (n) | 6 | 24 | 0 | 30 | 0.010 |
| | PERCENTAGE | 20 | 80 | 0 | 100 | |
| GROUP 2 | COUNT (n) | 0 | 30 | 0 | 30 | |
| | PERCENTAGE | 0 | 30 | 0 | 100 | |

**GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION**

**2. Mean time required for surgery** in-group 1 was 30.41 minutes and in-group 2 was 22.01 minutes. The observation is tabulated in **Table 3.**

**TABLE 3 - TIME REQUIRED FOR SURGERY**

| | Group | N | Mean | Std Deviation | P value* |
|---|---|---|---|---|---|
| TIME REQUIRED FOR SURGERY | **GROUP 1** | 30 | 30.4127 | 3.69715 | 0.000 |
| | **GROUP 2** | 30 | 22.0063 | 3.58703 | 0.000 |
| | TOTAL | 60 | 26.2095 | 5.56857 | 0.000 |

**ANOVA***

**3. Post-operative mouth opening** was assessed by measuring percentage decrease in mouth opening.

- ✓ The mean percentage decrease in mouth opening on first post operative day in-group 1 was 40.02 and in-group 2 was 30.77.
- ✓ The mean percentage decrease in mouth opening on third post-operative day in-group 1 was 37.17 and in-group 2 was 25.60.
- ✓ The mean percentage decrease in mouth opening on seventh post-operative day in-group 1 was 18.24, and in-group 2 was 13.88.
- ✓ The mean percentage decrease in mouth opening in 2$^{nd}$ week in-group 1 was 6.54, and in-group 2 was 4.40.
- ✓ The mean percentage decrease in mouth opening after 1$^{st}$ month in-group 1 was 1.69, in and in-group 2 was 0.89.
- ✓ The mean percentage decrease in mouth opening after 2$^{nd}$ month in-group 1 was 0.31, and in-group 2 was 0.23.
- ✓ The observations are tabulated in **table 4** and graphically represented in **graph 2**.

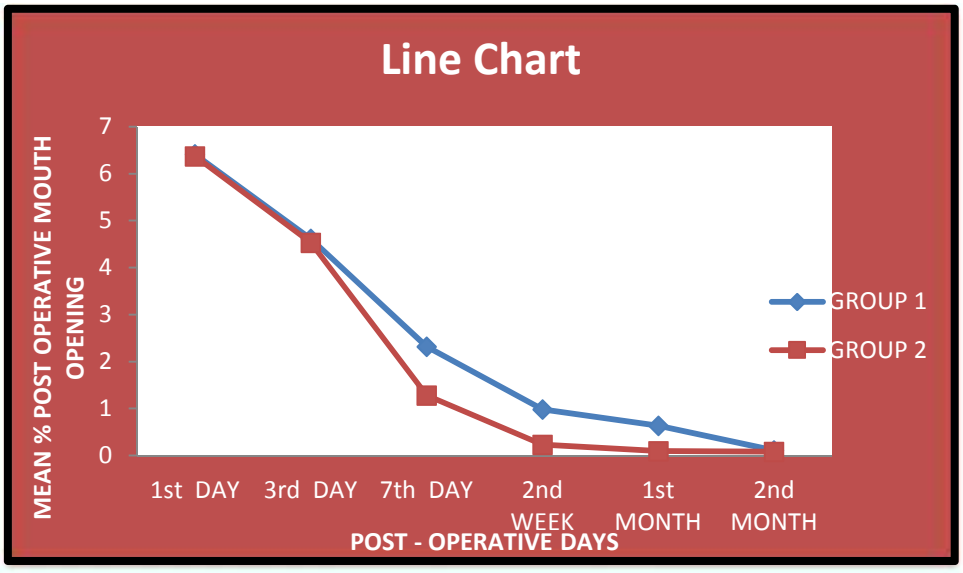
**TABLE 4 - PERCENTAGE DECREASE IN MOUTH OPENING**

| Mouth opening | Group | | | | P Value* |
|---|---|---|---|---|---|
| | Group 1 | | Group 2 | | |
| | Mean | SD | Mean | SD | |
| 1st post-op day | 40.0220 | 2.68847 | 30.7713 | 5.75903 | .000 |
| 3rd post-op day | 37.1707 | 2.88083 | 25.6020 | 6.32512 | .000 |
| 7th post-op day | 18.2377 | 2.42390 | 13.8770 | 3.21943 | .000 |
| 2nd post-op week | 6.5377 | 2.44391 | 4.3993 | 1.68525 | .000 |
| 1st post-op month | 1.6897 | 1.11326 | 0.8927 | 0.43371 | .008 |
| 2nd post-op month | 0.3053 | 0.30363 | 0.2290 | 0.29585 | .010 |

***ANOVA**

$$\text{Percentage decrease in mouth opening} = \frac{\text{(Preoperative measurement- Postoperative measurement)}}{\text{Preoperative measurement}} \times 100$$

**GRAPH 2: PERCENTAGE DECREASE IN MOUTH OPENING**




GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION

**4. Post-operative swelling** was measured using percentage increase in facial measurements.

- ✓ The mean percentage increase in facial measurements on first post-operative day in-group 1 was 11.79 and in-group 2 was 8.92.
- ✓ The mean percentage increase in facial measurements on third post-operative day in-group 1 was 11.15 and in-group 2 was 7.06. The mean percentage increase in facial measurements on seventh post-operative day in-group 1 was 2.67 and in-group 2 was 1.49.
- ✓ The mean percentage increase in facial measurements in 2nd week in-group 1 was 0.85 and in-group 2 was 0.18.
- ✓ The mean percentage increase in facial measurements after 1-month in-group 1 was 0.42 and in-group 2 was 0.06.
- ✓ The mean percentage increase in facial measurements after 2nd month in-group 1 was 0.06 and in-group 2 was 0.03.
- ✓ The observations are tabulated in **table 5** and graphically represented in **Graph 3**.

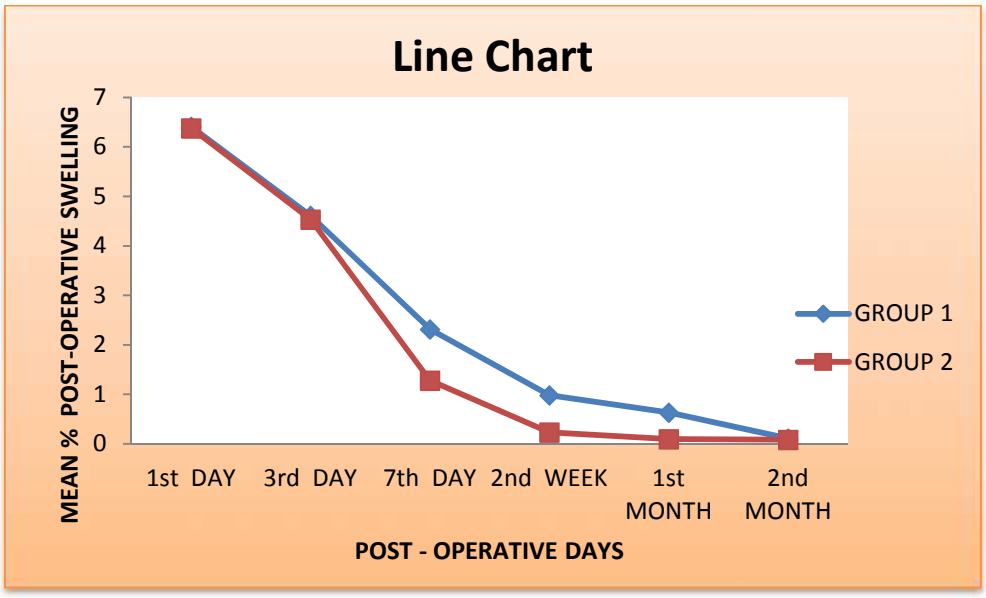
**TABLE 5 PERCENTAGE INCREASE IN FACIAL MEASUREMENT**

| % increase in facial measurement | Group | | | | P Value* |
|---|---|---|---|---|---|
| | Group 1 | | Group 2 | | |
| | Mean | SD | Mean | SD | |
| 1st post-op day | 11.7887 | 1.60585 | 8.9153 | 0.73235 | .000 |
| 3rd post-op day | 11.1473 | 1.49356 | 7.0647 | 1.07201 | .000 |
| 7th post-op day | 2.6713 | 0.90776 | 1.4970 | 0.34616 | .000 |
| 2nd post-op week | 0.8513 | 0.47707 | 0.1837 | 0.13878 | .000 |
| 1st post-op month | 0.4207 | 0.29307 | 0.0673 | 0.03638 | .000 |
| 2nd post-opmonth | 0.0603 | 0.03987 | 0.0363 | 0.02399 | .006 |

***ANOVA**

$$\text{Percentage increase in facial swelling} = \frac{\text{(Postoperative measurement- Preoperative measurement)}}{\text{Preoperative measurement}} \times 100$$

**GRAPH 3 -** PERCENTAGE INCREASE IN FACIAL MEASUREMENT




GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION

**5. Post-operative pain** was measured on Visual Analogue Scale (0-10).

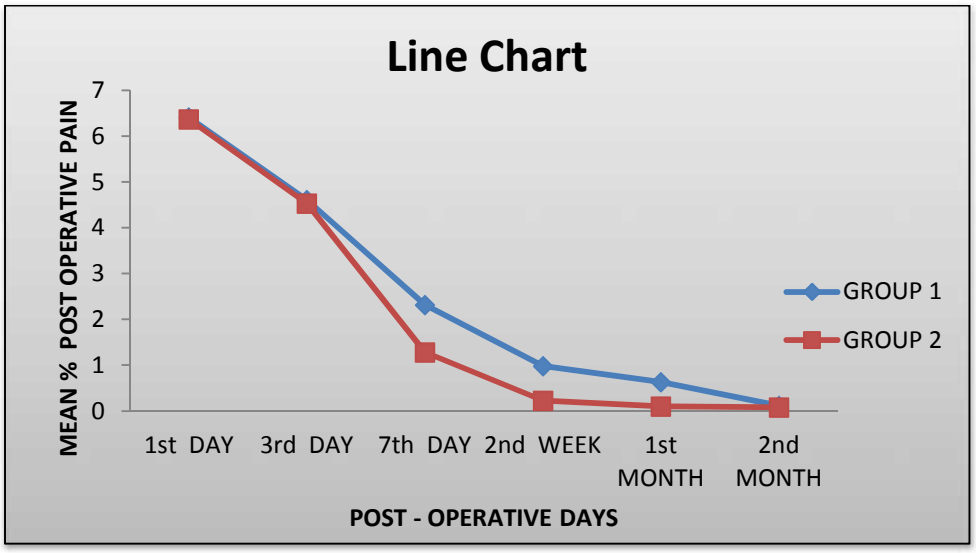
- ✓ The mean pain score on VAS scale on first post-operative day for group 1 was 6.41 and for group two were 4.37.
- ✓ The mean pain score on VAS scale on third post-operative day for group 1 was 4.61 and for group two were 2.53.
- ✓ The mean pain score on VAS scale on seventh post-operative day for group 1 was 2.31 and for group 2 was 1.28.
- ✓ The mean pain score on VAS scale in second post-operative week for group 1 was 0.98 and for group 2 was 0.23.
- ✓ The mean pain score on VAS scale after 1 month post-operatively for group 1 was 0.63 and for group 2 was 0.98.
- ✓ The mean pain score on VAS scale after 2 months post-operatively for group 1 was 0.11 and for group 3 was 0.0.

The observations are tabulated in **table 6** and graphically represented in **Graph 4**.

**TABLE 6 - POST OPERATIVE PAIN (VAS)**

| Operative Pain (VAS) | Group | | | | P Value* |
|---|---|---|---|---|---|
| | Group 1 | | Group 2 | | |
| | Mean | SD | Mean | SD | |
| 1st post-op day | 6.4120 | .96635 | 4.3743 | 1.13310 | **.005** |
| 3rd post-op day | 4.6123 | .67201 | 2.5340 | .72108 | **.000** |
| 7th post-op day | 2.3187 | .63385 | 1.2823 | .20219 | **.057** |
| 2nd post-op week | .9820 | .24727 | .2310 | .10189 | **.065** |
| 1st post-op month | .6323 | .44526 | .0983 | .06665 | **.056** |
| 2nd post-opmonth | .1127 | .13577 | .0820 | .05455 | **.050** |

**GRAPH 4 -POST OPERATIVE PAIN**



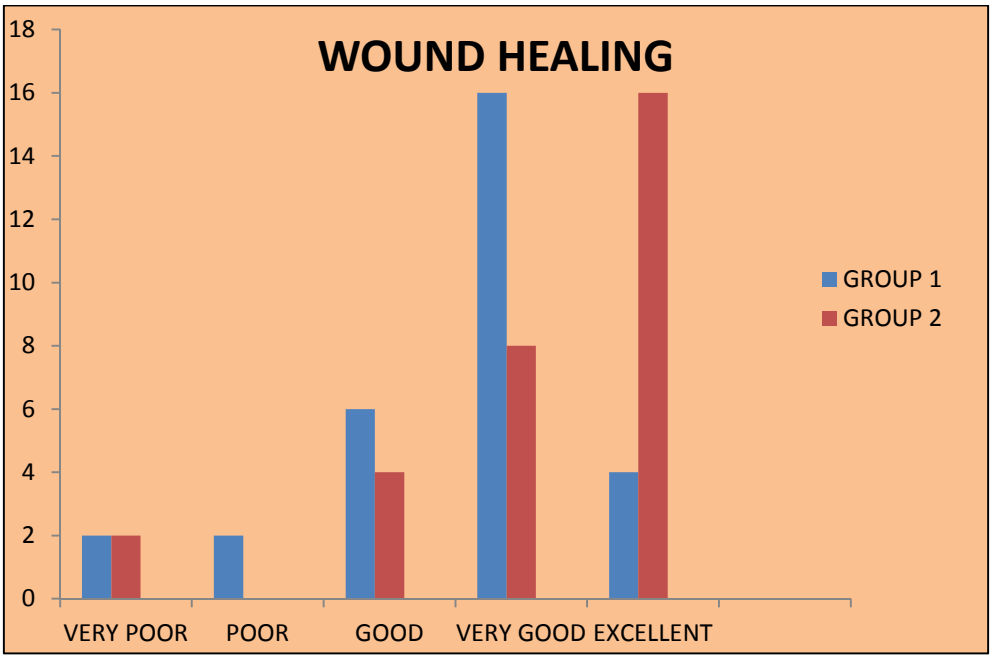

**GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION**

**6. Wound healing** was very poor in 2(6%) patients, poor in 2 patients (6%), good in 6 patients (20%) ,very good in 16 patients (53%) and excellent in 4 patients (14%) from group 1 and in group 2 the healing was very poor in 2(6%) patients, good in 4 patients (14%) ,very good in 8 patients (27%) and excellent in 16 patients (53%).The observations are tabulated in **table 7** and graphically represented in **graph 5**.

## TABLE 7 - WOUND HEALING

| Group | | Wound Healing | | | | | Total | P value |
|---|---|---|---|---|---|---|---|---|
| | | Very poor | Poor | Good | Very good | Excellent | | |
| GROUP 1 | COUNT (n) | 2 | 2 | 6 | 16 | 4 | 30 | 0.000 |
| | PERCENTAGE | 6 | 6 | 20 | 53 | 14 | 100 | |
| GROUP 2 | COUNT (n) | 2 | 0 | 4 | 8 | 16 | 30 | |
| | PERCENTAGE | 6 | 0 | 14 | 27 | 53 | 100 | |

## GRAPH 5: POST OPERATIVE WOUND HEALING



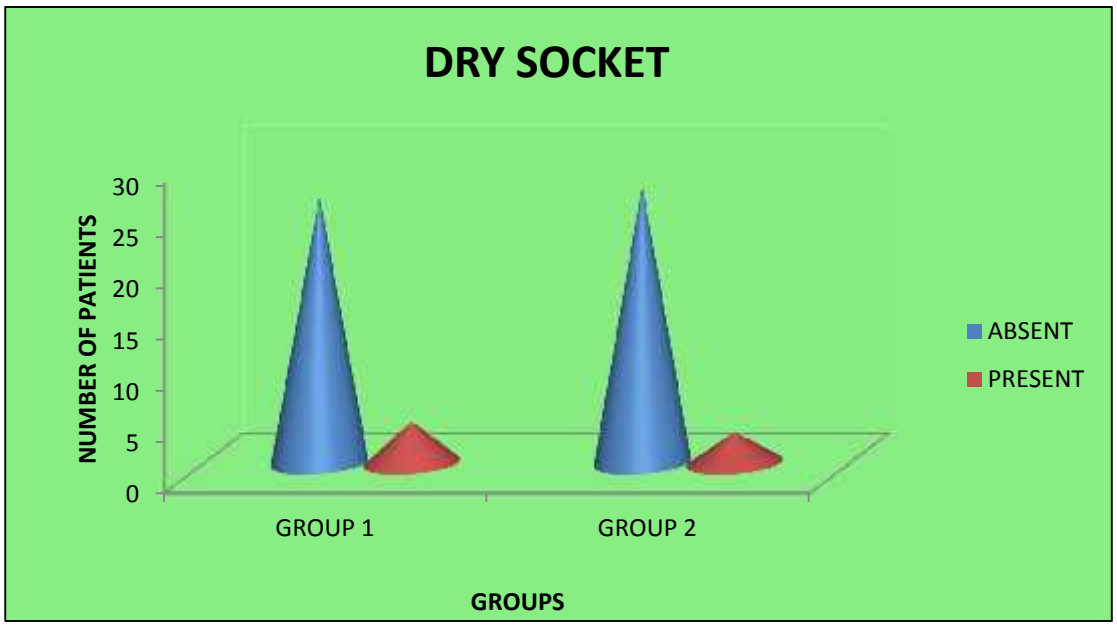

GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION

**7. Dry socket** was present in four patients from group 1 (13.3%), and in two patient from group 2 (6.6%). The observations are tabulated in **table 8** and graphically represented in **graph 5**.

**TABLE 8. DRY SOCKET**

| Group | | Dry socket | | Total | P value |
|---|---|---|---|---|---|
| | | Absent | Present | | |
| GROUP 1 | COUNT (n) | 26 | 4 | 30 | 1.000 |
| | PERCENTAGE | 86.7 | 13.3 | 100 | |
| GROUP 2 | COUNT (n) | 28 | 2 | 30 | |
| | PERCENTAGE | 93.3 | 6.6 | 100 | |

**GRAPH 6 – DRY SOCKET**



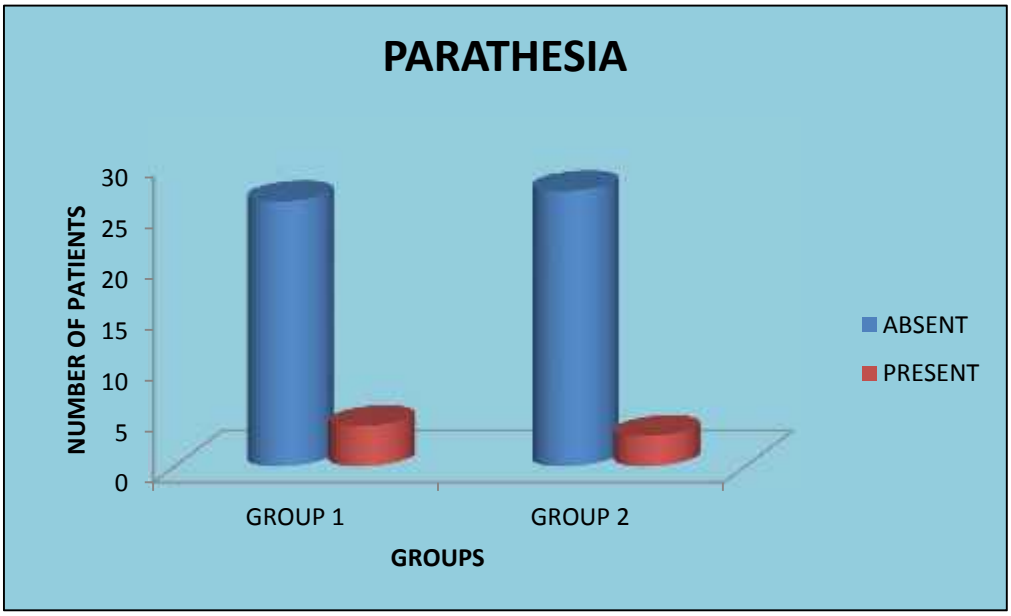

**GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION**

**8. Paraesthesia** was present in four patient from group one (13.3%), in three patient from group 2 (10%). The observations are tabulated in **table 9** and graphically represented in **graph 7**.

**TABLE 9 -PARAESTHESIA**

| Group | | Paraesthesia | | Total | P value |
|---|---|---|---|---|---|
| | | Absent | Present | | |
| GROUP 1 | COUNT (n) | 26 | 4 | 30 | 1.000 |
| | PERCENTAGE | 86.7 | 13.3 | 100 | |
| GROUP 2 | COUNT (n) | 27 | 3 | 30 | |
| | PERCENTAGE | 90 | 10 | 100 | |

**GRAPH 7 – PARAESTHESIA**



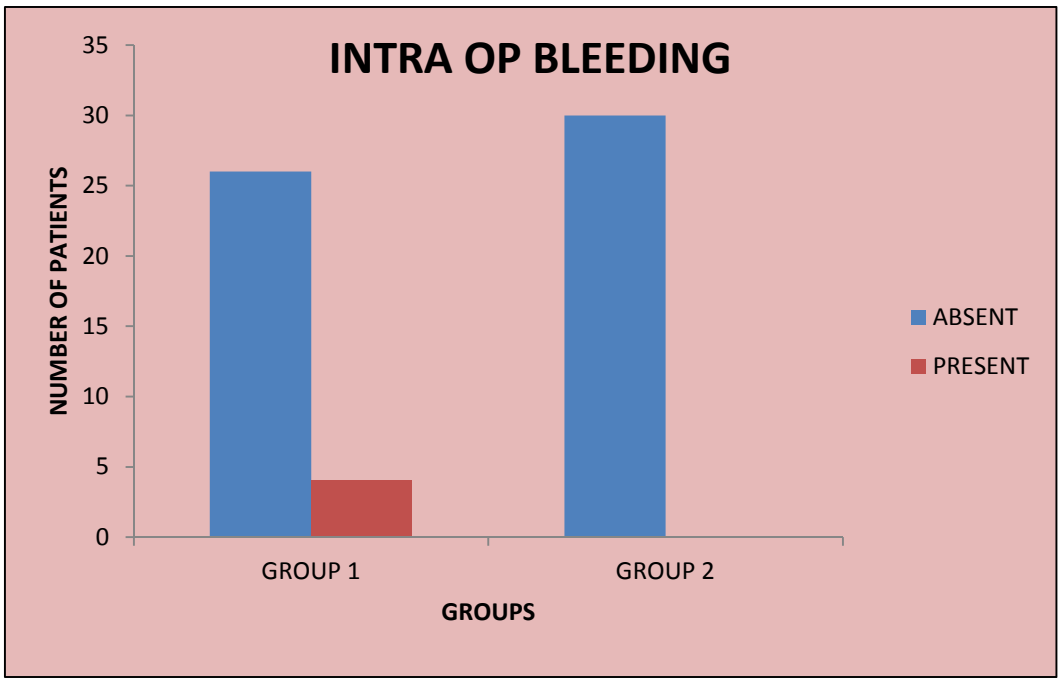

**GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION**

**9.Intra operative bleeding** was present in all 30 cases(100%) in group 1 and in 4 cases(13.3% )in group 2.The observations are tabulated in **table 10** and graphically represented in **graph 8**.

**TABLE 10 – INTRA OP BLEEDING (VAS SCORE)**

| Group | | Intra OP Bleeding | | | |
|---|---|---|---|---|---|
| | | Present | Absent | Total | Pvalue |
| GROUP 1 | COUNT (n) | 30 | 0 | 30 | 0.000 |
| | PERCENTAGE | 100 | 0 | 100 | |
| GROUP 2 | COUNT (n) | 4 | 26 | 30 | |
| | PERCENTAGE | 13.3 | 86.7 | 100 | |

**GRAPH 8 – INTRA OP BLEEDING**



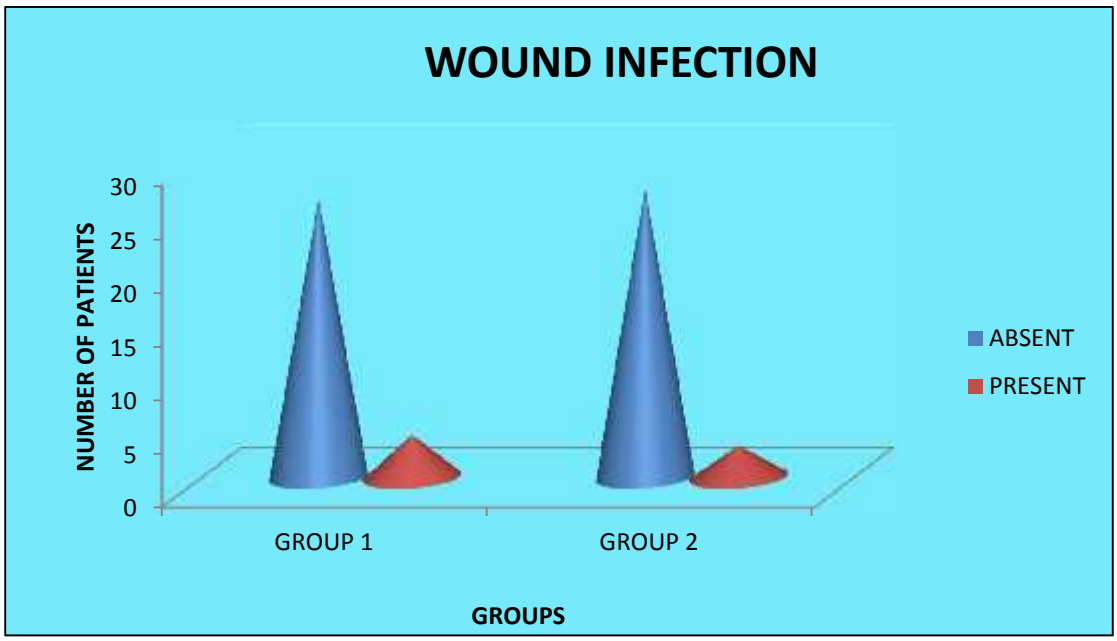

**GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION**

**10. Wound infection** was present in 4 patients from group 1 (13.3%), and in 2 patient from group 2 (6.6%). The observations are tabulated in **table 11 and** graphically represented in **graph 9.**

**TABLE 11-WOUND INFECTION**

| Group | | Dry socket | | Total | P value |
|---|---|---|---|---|---|
| | | Absent | Present | | |
| GROUP 1 | COUNT (n) | 26 | 4 | 30 | 1.000 |
| | PERCENTAGE | 86.7 | 13.3 | 100 | |
| GROUP 2 | COUNT (n) | 28 | 2 | 30 | |
| | PERCENTAGE | 93.3 | 6.6 | 100 | |

**GRAPH 9-WOUND INFECTION**




**GROUP 1 – SCALPEL INCISION GROUP 2 – LASER INCISION**

**STATISTICAL ANALYSIS:**

Software used: SPSS, Version 20.0

Concept of P value

- ✓ If the P value is 0.000 to 0.010 it implies (Highly Significant)
- ✓ If the P value is 0.011 to 0.050 it implies (Significant)
- ✓ If the P value is 0.051 to 1.000 it implies (Not Significant)
- ✓ If the P value is .000 then put as <0.001

**STATISTICAL TESTS USED**:

- ✓ Qualitative data - Chi Square Test
- ✓ Quantitative data- ANOVA

# DISCUSSION

Third molars are the most frequently impacted tooth in the oral cavity. If third molars are not removed they may lead to cyst formation, resorption of roots of adjacent teeth and malocclusion. The common complications following surgical removal of third molar are pain, swelling and reduction in mouth opening that are triggered by inflammatory processes initiated by surgical trauma.[53] Patients generally experience a deterioration in their quality of life due to complications caused by surgical removal of third molar.[45] Flap design and incision is one of the factors influencing the severity of these complications. The incision of the mucosa, the reflection of a mucoperiosteal flap and the surgical time are the general factors related to post operative complications.[94]

Several trials have been used to prevent the occurrence of these complications by alteration in the surgical operative technique and reducing trauma as possible, by the administration of local or systemic corticosteroids and anti-inflammatory drugs, different types of incisions and Laser therapy. The present study compares the standard WARD'S incision with laser and scalpel in terms of intra operative ease of access, time required, intra op bleeding, post-operative trismus, swelling, pain and wound healing, dry socket, paresthesia, wound infection.

**EASE OF ACCESSBILITY AND VISIBILITY:**

In the present study, ease of access was assessed in terms of visibility and accessibility. The results showed that access was excellent (100%) in all surgeries performed using laser incision. However, it was excellent in 80% and moderate in 20% of surgeries, which were performed using scalpel incision. The result showed that laser incision provides excellent access to the surgical site as compared to scalpel incision .The results were in accordance with the study done by Azma et al. [76] who noted that incisions with Laser provide easier access and visibility in oral surgery because of the bloodless operating field.

**TIME REQUIRED FOR THE SURGERY:**

The results showed significant difference in terms of time required for the surgery. The mean time required in minutes for surgery was 30.41 min in surgeries performed by scalpel incision while it was 22 min in incision by Laser respectively. Least time was required for surgeries performed using Laser incision because of the bloodless operating field and comfort of the patient. More time was required for surgeries performed by scalpel incision because of inaccessibility to the surgical field by the pooling of the blood. These results were in accordance with the study done by Azma E et al.[76] Mazarei sotoode et al[79] who noted that time required for oral surgical procedure performed by Laser incision was more as compared to scalpel incision but the results were contradictory to the study done by Amaral et al.[80]

This disparity may be due to facts like depth , position of the tooth, reflection of flap and experience of the surgeon.

**POST OPERATIVE MOUTH OPENING**:

The inter-incisal distance has been used as a measure of trismus in previous studies, although most of the studies did not specify the measurement device used. In the present study ruler and calibrated divider were used to measure inter-incisal distance. The percentage difference in reduction of mouth opening was calculated on 1$^{st}$, 3$^{rd}$, 7$^{th}$ post-operative days, 2$^{nd}$ post-operative week, 1$^{st}$ and 2$^{nd}$ post-operative month. The mean percentage difference was calculated using.

$$\textbf{Percentage decrease in mouth opening} = \frac{\textbf{(Preoperative measurement- Postoperative measurement)}}{\textbf{Preoperative measurement}} \times 100$$

In the present study the mean percentage decrease in mouth opening on first post operative day in-group 1 was 40.02 and in-group 2 was 30.77. The mean percentage decrease in mouth opening on third post-operative day in-group 1 was 37.17 and in-group 2 was 25.60. The results were significant showing scalpel incision affected post-operative mouth opening to the maximum level on 1$^{st}$ and 3$^{rd}$ postoperative days when compared with Laser incision. The results were as minimal as possible on the 7$^{th}$ day , 2 week, 1$^{st}$ and 2$^{nd}$ month post operatively for both scalpel and Laser incision. The results were in accordance with a study done by Landucci et al .[53]These results are in contradictory to a study done by Amaral et al[80], in which he noted

similar effect on mouth opening post-operatively irrespective of the incision used. The reason for this disparity may be attributed to various other factors like duration of surgery and reflection of flap for longer duration.

**POST OPERATIVE SWELLING**:

In a clinical study by Landucci et al [53] and Mahitab Mahmad et al [96] it was noted that swelling is mostly related to the incision, reflection of the mucoperiosteal flap and the duration of the procedure. This pattern probably results from the prolonged manipulation of the open wound. The action of Laser on cell membranes causes the absorption of photons by the mitochondria. This in turn stimulates the increased production of Adenosinetriphosphate (ATP) and low level of Reactive Oxygen Species (ROS) which activates transcription factors such as NF-kappaB. These changes may induce many gene transcript products which are responsible for the reduction in the swelling. The present study is in corelation with this study. In the present study, the percentage increase in facial measurements was calculated on 1$^{st}$, 3$^{rd}$, 7$^{th}$ post-operative days, 2$^{nd}$ post-operative week, 1$^{st}$ and 2$^{nd}$ post-operative month and the mean was taken. The results showed that increased post-operative swelling was observed after surgeries performed using scalpel incision as compared to Laser incision. However, these results are in contradiction to the study done by Roynesdal AK et al [97]. This may be explained by the administration of

comparatively a low dose of analgesics at short intervals between assessments.

**POST OPERATIVE PAIN**:

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. Pain is a symptom commonly expected after surgery and may vary considerably according to surgical difficulty and individual pain thresholds. Following third molar extraction, the pain intensity peaks after 3–5 hours and the pain continues for 2–3 days postoperatively, gradually diminishing by the seventh postoperative day. A similar pattern of pain occurrence was observed in the present study. In the present study, post-operative pain was assessed on 1$^{st}$, 3$^{rd}$, 7$^{th}$ post-operative days, 2$^{nd}$ post-operative week, 1$^{st}$ and 2$^{nd}$ post-operative month by using a Visual Analogue Scale (VAS), which ranges from 0-10 in ascending order of pain, as it takes little time to describe to the patient and it is easily understood by the patient. The results showed insignificant difference in two incision groups, Post-operative pain scores were almost similar after surgeries performed by scalpel incision and Laser incision. This is in accordance with the studies done by Roynesdal AK et al [97] and contradiction to Landucci et al [53] and Mahitab Mahmoud et al [96], which noted less pain in Laser incision group. The disparity may be due to the surgical procedures are not performed simultaneously, the patients' pain thresholds may change according to their initial surgical; experiences.

**WOUND HEALING:**

In the present study, out of 30 surgeries performed using scalpel incision 16 cases(53%) was found to have very good wound healing and 4 cases (14%) excellent wound healing in the post-operative period. Out of 30 surgeries performed using Laser incision 8 cases (27%) had very good and 16 cases (53%) had excellent wound healing in the post-operative period, The difference amongst the two incision groups was significant. This result was similar with Karu T et al[86] in which he has stated that enhanced wound healing are due to photobiomodulation of Laser at the cellular level; rapid healing is promoted by a reduction in toxins as a result of accelerated lymphatic flow, thereby enhancing repair and inducing regeneration This is in contradiction with a study by Amaral et al[80] who didn't found any significant difference between the Laser and control group.

**WOUND INFECTION**:

Infection can be defined as the state of invasion of bodily tissue by pathogenic microorganism that proliferate, resulting in a tissue injury that can progress to disease. Micro-organisms isolated from third impacted molar region were 80% Prevotelladenticola 40% Corynebacterium spp. and 40%Lactobacillus spp. .Laser beams aid in the action of inactivation of bacterial cells accompanied by alterations of the structure of the cells, e.g. elongated cells connected together without separation of the daughter cells, disordered cell wall structure; and different low density areas in the cytoplasm The difference may be

due to enforced patient education after the development of infection in the control side, which would have been followed after the surgery of the study side. The difference amongst the two incision groups was not significant. This is in accordance with a study by Amaral et al [80] but in contradiction to the study by Mahitab Mahmoud [96] who concluded that the rate of wound infection is reduced by 4% in the Laser incision group compared to scalpel based on his observation that the bactericidal effect of the Diode Laser was clearly evident by greater reduction of CFUs/ml of obligate anaerobes in the test group than in the control group.

**DRY SOCKET:**

The normal sequence of extraction socket healing does not always occur. The alveolar ostetitis (dry socket) is a disturbance in healing process before the matures blood clot gets replaced by granulation tissue. The primary etiology was found to be due to excess of fibronolysis released due to smoking, bacteria and saliva. Dry sockets are more common in mandible than in maxilla because of accumulation of food derbis will be more in lower socket than the upper and due to relatively poor blood supply of mandible. In the present study, out of 30 surgeries performed bilaterally using Scalpel and Laser incision, in the scalpel incision 4 cases was found to develop dry socket in the post-operative period while in Laser incision 2 cases was found to develop dry socket in the post-operative period. The difference amongst the two incision groups was not significant.

**PARETHESIA:**

Sensory deficit following the third molar surgery present as hypothesia, hyperthesia, anesthesia or dysthesia due to the disturbance in Inferior alveolar nerve or lingual nerve. The lingual nerve is the most common nerve to be injured during the surgical removal of third molar because of the soft tissue flap reflection. Parethesia is defined as an abnormal sensation of prickling , tingling or creeping on the surface having no objective cause and usually associated with injury or irritation of a sensory nerve or nerve root. In the present study, out of 30 surgeries performed bilaterally using Scalpel incision and Laser incision, in scalpel group 4 cases was found to develop transient paresthesia in the post-operative period. In addition, in Laser incision 3 cases was found to develop paresthesia in the post-operative period, the paresthesia was not permanent and resolved after 4 weeks. The difference amongst the two incision groups was not significant. This parameter has not been assessed in comparison with two incision groups in previous studies.

**INTRA OPERATIVE BLEEDING**:

Normal bleeding time (2-6 min) and clotting time (4 – 9 min). By using Lasers in the placement of incision the blood vessels are subjected to photocoagulation and thermocoagulation. This leads to the shrinkage of proteins in the vessel's wall that in turn seal off the blood flow. In the present study out of 30 surgery performed bilaterally using scalpel and laser incision, the intra operative bleeding was

present in all 30 cases in scalpel incision while only in 4 cases (13.3%) in Laser incision group .This result is highly significant and in accordance with the Mahitab Mahmoud and Amaral et al[80,96]

This study clearly indicated that the incision does affect the post-operative consequences following surgical removal of impacted mandibular third molars. **Laser incision provided excellent accessibility and visibility** to the surgical site. **Time required for performing surgery-using Laser incision was less** as compared to scalpel incision. The Laser incision proved to be **least affecting the post-operative mouth opening, swelling. Postoperative wound healing was excellent** followed by incision with Laser. **Intra operative bleeding was highly reduced** by the use of lasers. Scalpel incision proved to be moderately affecting these parameters. There was no significant difference found among the two incision groups in terms wound infection, dry socket, paresthesia and pain post-operatively.

# SUMMARY AND CONCLUSION

This study was conducted in the department of Oral and Maxillofacial Surgery at Madha Dental College and Hospital, Chennai on 30 patients with bilaterally impacted mandibular third molars, which were, removed surgically using two different kinds of incisions, and several parameters were studied post-operatively in these cases to assess the clinical outcomes. 30 patients with bilateral impaction were divided into two groups namely Group 1 (Scalpel), Group 2 (Laser). Under Group 1 the impacted mandibular third molars were removed surgically using the conventional scalpel incision, under Group 2 laser incision was used Post-operative sequelae were assessed on the 1$^{st}$, 3$^{rd}$, 7$^{th}$ day, 2$^{nd}$ week, 1$^{st}$ month and 2$^{nd}$ month for all the operated patients. The purpose of this study was to evaluate the merits and demerits of all the two method of incisions.

The results of this study shows significant difference with respect to accessibility to surgical site, time required for the surgery, intra operative bleeding, post-operative decrease in mouth opening, post-operative swelling and post-operative wound healing. Significant differences were not noted with respect to postoperative pain, wound infection, dry socket and paresthesia.

**The present study gives the following inferences -**

1. **LASER incision** provided **excellent access** to the surgical site as compared to scalpel.
2. **Time required** for the surgery was **least** with the use of **LASER incision**, while it was more with scalpel incision.
3. Post-operative mouth opening, post-operative swelling and post-operative wound healing was affected more adversely with the use of scalpel incision while these parameters were least adversely affected with the use of laser incision.

The conclusion of this study shows that incision with lasers was more prefered when compared to scalpel incision, although it may require some practice initially and a broader study group of patients under each category is recommended.

# BIBLIOGRAPHY


1. **Archer WH**. Oral Surgery: A Step-By-Step Atlas of Operative Techniques, 4th ed. Philadelphia: W.B. Saunders Company; 1966. p. 507-10.
2. **Peterson LJ, Ellis E III**, **Hupp JR, Tuker MR**. Principles of Management of Impacted Teeth. Contemporary Oral and Maxillofacial Surgery, 3rd ed. St. Louis: Mosby; 1998. p. 215-48.
3. **Agarwal KN, Gupta R, Faridi MM, Kalra N.** Permanent dentition in Delhi boys**.** Indian Pediatr. 2004 Oct;41(10):1031-5.
4. **Padhye MN, Dabir AV, Girotra CS, Pandhi VH**. Pattern of mandibular third molar in the Indian population: a retrospective clinico-radiographic survey. Oral Surg Oral Med Oral Pathol Oral Radiol 2013;116:161–6.
5. **Rantanen AV**. The age of eruption of the third molar teeth. Acta Odontol Scand 1967;25(Suppl 1):48
6. **Lysell L, Rohlin M**. A study of indications used for removal of the mandibular third molar. Int J Oral Maxillofac Surg 1988;17:161–164
7. **Ricketts RM**. Studies leading to the practice of abortion of lower third molars. Dent Clin North Am 1979;23:393–411.
8. **Raghoebar GM, Boering G, Vissink A, Stegenga B**. Eruption disturbances of permanent molars: a review. J Oral Pathol Med 1991;20:159–66.

9. **Bamgbose BO, Akinwande JA, Adeyemo WL, Ladeinde AL, Arotiba GT, Ogunlewe MO**. Effects of co-administered dexametha- sone and diclofenac potassium on pain, swelling and trismus following third molar surgery. Head Face Med 2005;7:11
10. **Camillo D'Arcangelo, DDS**. A preliminary study of healing of diode laser versus scalpel incisions in rat oral tissue: a comparison of clinical, histological, and immunohistochemical results. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103:764-73.
11. **Sulewski JG**. Historical survey of laser dentistry. Dent Clin North Am 2000;44(4):71752.
12. **Pick RM, Colvard MD.** Current status of lasers in soft tissue dental surgery. J Periodontol 1993;64:589‑602.
13. **Alling CC, Alling RD**. Indications for management of impacted teeth.Impacted Teeth. Philadelphia: W.B. Saunders; 1993. p. 49-54.
14. **Hattab FN, Alhaija ES**. Radiographic evaluation of mandibular third molar eruption space. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1999 Sep;88(3):285-91.
15. **Elsey MJ, Rock WP**. Influence of orthodontic treatment on development of third molars. Br J Oral Maxillofac Surg. 2000 Aug;38(4):350-3.
16. **Yuasa H, Sugiura M**. Clinical postoperative findings after removal of impacted mandibular third molars: prediction of

postoperative facial swelling and pain based on preoperative variables. Br J Oral Maxillofac Surg. 2004 Jun;42(3):209-14.

17. **Björk A**. Prediction of mandibular growth rotation. Am J Orthod 1969;55:585–99.
18. **Richardson M**. The development of third molar impaction. Br J Orthod. 1975 Oct;2(4):231-4.
19. **Grover PS, Lorton L**. The incidence of unerupted permanent teeth and related clinical cases. Oral Surg Oral Med Oral Pathol. 1985 Apr;59(4):420-5.
20. **Richardson M.** Changes in lower third molar position in the young adult. Am J Orthod Dentofacial Orthop. 1992 Oct;102(4):320-7.
21. **Lytle JJ.** Etiology and indications for the management of impacted teeth. Northwest Dent. 1995 Nov-Dec;74(6):23-32.
22. **Yamaoka M, Tambo A, Furusawa K**. Incidence of inflammation in completely impacted lower third molars. Aust Dent J. 1997 Jun;42(3):153-5.
23. **Winter G**. Impacted Mandibular Third Molar**.** StLouis, American Medical Book Co. 1926.
24. **Pell GJ GB**. Impacted mandibular third molars: classification and modified techniques for removal. **Dent** 1933; 39: 330-8.
25. **Quek SL, Tay CK, Tay KH, Toh SL, Lim KC.** Pattern of third molar impaction in a Singapore Chinese population: a retrospective radiographic survey. Int J Oral Maxillofac Surg. 2003; 32: 548-52.

26. **Sanjeev Kumar , Mahendra P. Reddy , Lokesh Chandra •, Alok Bhatnagar**. The ‘‘Red Line’’ Conundrum: A Concept Beyond Its Expiry Date? J. Maxillofac. Oral Surg. (Oct–Dec 2014) 13(4):612–614

27. **Mac Gregor AJ** . The impacted lower wisdom tooth 1st edition: oxford1985

28. **Chiapasco M, DeCicco L, Marrone G**. Side effects and complications associated with third molar surgery. **Oral Surg Oral Med Oral Pathol** 1993; 76: 412–20.

29. **Peterson LJ**. “Principles of management of impacted teeth,” in Contemporary Oral and Maxillofacial Surgery, Peterson LJ, Ellis E, Hupp JR, Tucker MR. Eds., Mosby, Chicago, Ill, USA, 4th ed 2003

30. **Diniz-Freitas M. Lago-M´endez L, Gude-Sampedro F, Somoza-Martin JM, G´andara-Rey JM.** Garc´ıa-Garc´ıa,“Pederson scale fails to predict how difficult it will be to extract lower third molars,” ***Br J Oral Maxillofac Surg*** 2007; 45: 23–26.

31. **Kharma MY , Sakka S, Aws G, Tarakji B, and Nassani MZ**. Reliability of Pederson Scale in Surgical Extraction of Impacted Lower Third Molars: Proposal of New Scale. J Oral Dis.20l4 ID157523

32. **Bishara SE, Andreasen G**. Third molars: a review. Am J Orthod. 1983 Feb;83(2):131-7.

33. **Denio D, Torabinejad M, Bakland LK**. Anatomical relationship of the mandibular canal to its surrounding structures in mature mandibles. J Endod. 1992 Apr;18(4):161-5.

34. **Flygare L, ohman A**, preoperative imaging procedures for lower wisdom teeth removal. Clin oral Investig. 2008 dec : 12(4): 291 – 302.

35. **Ghaeminia H, Meijer GJ, Soehardi A, Borstlap WA, Mulder J, Vlijmen OJ, Bergé SJ, Maal TJ**. The use of cone beam CT for the removal of wisdom teeth changes the surgical approach compared with panoramic radiography: a pilot study. Int J Oral Maxillofac Surg. 2011 Aug;40(8):834-9.

36. **Matzen LH, Christensen J, Hintze H, Schou S, Wenzel A**. Influence of cone beam CT on treatment plan before surgical intervention of mandibular third molars and impact of radiographic factors on deciding on coronectomy vs surgical removal. Dentomaxillofac Radiol. 2013;42(1):98870341.Epub 2012 Aug 29.

37. **Juodzbalys G, Daugela P**. Mandibular third molar impaction: review of literature and a proposal of a classification. ***J Oral Maxillofac research***. 2013;42e1

38. **National Institute of Health**.Removal of third molars. Sponsored by the National Institute of Dental Research, November 28-30, 1979. Natl Inst Health Consens Dev Conf Summ. 1979;2:65-8.

39. **Koerner KR.** The removal of impacted third molars. Principles and procedures. Dent Clin North Am. 1994 Apr;38(2):255-78.

40. **The National Institute of Clinical Excellence (NICE)** of England guidance for wisdom tooth removal.2003.

41. **Kruger G**. Management of impactions Dent Clin North Am 1969;19:707

42. **Thoma KH** oral surgery 5th edition l 1: 1969

43. **Geoffrey Howe.** Minor oral surgery 3rd edition 1985

44. **Mac Gregor AJ** . The impacted lower wisdom tooth**.** 1st edition: oxford1985

45. **Savin J, Ogden GR:** Third molar surgery–A preliminary report on aspects affecting quality of life in the early postoperative period. Br J Oral Maxillofac Surg 35:246, 1997

46. **McGrath C, Comfort MB, Lo EC, Luo Y.** Changes in life quality following third molar surgery the immediate postoperative period. Br Dent J 2003;194:265–8

47. **Hawkins D, Houreld N, Abrahamse H.** low level laser therapy (LLLT) as an ef-fective therapeutic modality for delayed wound healing. *Ann N Y Acad Sci*. 2005; 1056:486-493

48. **Aras MH, Güngörmüs¸ M.** The effect of low-level laser therapy on trismus and facial swelling following surgical extraction of a lower third molar. *Photomed Laser Surg* 2009;**27**:21–4.

49. **Jovanovic G, Buric´ N, Kesic´ L.** Effect of low power laser on postoperative trismus. Facta Univ Ser Med Biol 2004;11 Jovanovic G:136–8

50. **Negreiros RM, Biazevic MG, Jorge WA, Michel-Crosato E.** Relationship between oral health-related quality of life and the position of the lower third molar: postopera-tive follow-up. J Oral Maxillofac Surg 2012;70:779–86

51. **G. Gasperini, I.C. Rodrigues de Siqueira, L. Rezende Costa**, Does low-level laser therapy decrease swelling and pain resulting from orthognathic surgery? Int. J. Oral Maxillofac. Surg. 2014

52. **Farnaz Falaki, Amir Hossein Nejat, Zohreh Dalirsani et al**, The effect of low -level laser therapy on trigeminal neuralgia : A review of literature .J Dent Res Dent Clin Dent Prospect

53. **Landucci A,Wosny L.C,Uetanabaro** et al. Efficacy of a single dose of low-level laser therapy in reducing pain, swelling, and trismus following third molar extraction surgery, Int J Oral Maxillofac Surg (2015)

54. **Kim K, Brar P, Jakubowski J, Kaltman S, Lopez E**. The use of corticosteroids and nonsteroidal antiinflammatory medication for the management of pain and inflammation after third molar surgery: a review of the literature. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;107: 630–40.

55. **Marta López-Ramírez & Miguel Ángel Vílchez-Pérez &Jordi Gargallo-Albiol** et al, Efficacy of low-level laser therapy in the management of pain, facial swelling, and postoperative trismus after a lower third molar extraction. A preliminary study. Lasers Med Sci (2012) 27:559–566.

56. **Pecaro BC, Garehime WJ**. The CO2 laser in oral and maxillofacial surgery. J Oral Maxillofac Surg 1983;41: 725–8.

57. **Fisher SE, Frame JW.** The effects of the carbon dioxide laser on oral tissues. Br J Oral Maxillofac Surg 1984;22:414–25.

58. **Basu MK, Frame JW, Rhys Evans PH**. Wound healing following partial glossectomy using the CO2 laser, diathermy and scalpel: a histological study in rats.J Laryngol Otol. 1988;102:322-7.

59. **Roodenburg JL, ten Bosch JJ, Borsboom PC**. Measurement of the uniaxial elasticity of oral mucosa in vivo after CO2 laser evaporation and surgical excision. Int J Oral Maxillofac Surg 1990;19:181–3.

60. **Fisher SE, Frame JW, Browne RM, Tranter RM**. A comparative histological study of wound healing following CO2 laser and conventional surgical excision of canine buccal mucosa. Arch Oral Biol 1983;28:287–91.

61. **Kaminer R, Liebow C, Margarone JE, Zambon JJ**.Bacteremia following laser and conventional surgery in hamsters. J Oral Maxillofac Surg 1990;48:45 -8.

62. **Shuller DE**: Use of the laser in the oral cavity. Otolaryngology Clin North Am. 1990; 28:287.

63. **Gaspar L.** The use of high-power lasers in oral surgery. J Clin Laser Med Surg 1994;12:281–5.

64. **Strauss R**. Laser management of discrete lesions. In: Catone G, Alling C, editors. Laser applications in oral and maxillofacial surgery. Philadelphia: WB Saunders; 1997.

65. **Guy A, CharlesC.** : Laser applications in oral and maxillofacial surgery. chapter 2 photobiology of laser on oral and maxillofacial surgery. 1997; Pp 32-38.

66. **Romanos G, Nentwig G.** Diode laser (980 nm) in oral and maxillofacial surgical procedures : clinical observat66.ions based on clinical applications. J Clin Laser Med Surg 1999;17:193–7.

67. **George romanos D.D.S et al**. Diode laser (980nm) in oral and maxillofacial surgical procedures : clinical observations based on clinical applications. Journal of clinical laser medicine & surgery 1999;5:193- 197.

68. **Zeinoun T, Nammour S, Dourov N, Aftimos G, LuomanenM**. Myofibroblasts in healing laser excision wounds. Lasers Surg Med 2001;28(1):74 –9.

69. **Kreisler M, Gotz H, Duschner H, d'Hoedt B**. Effect of Nd:YAG, Ho:YAG, Er:YAG, CO2, and GaAIAs laser irradiation on surface properties of endosseous dental implants. Int J OralMaxillofac Implants 2002;17:202–11.

70. **Robert A. Strauss, DDS, MD**.Lasers in contemporary oral and maxillofacial surgery. Dent Clin N Am 48 (2004) 861–888

71. **Convissar RA**. Principles and practice of laser dentistry: Mosby; 2010

72. **D. Yazicioglu , N. Sayan, O. Gunhan** .The Assessment of the Influence of Diode Laser, Electrosurgery and Scalpel on Wound Healing and Hemostasis in Anticoagulated and Diabetic Rats . AAOMS conference, 2010.

73. **Suter VG, Altermat HJ, Sendi P, Mettraux G, Bornstein MM**. $Co_2$ and diode laser for excisional biopsies of oral mucosal lesions. Schweis Monatsshr Zahnmed 2010;120(8):664-71.

74. **Shalawe WS, Ibrahim ZA, Sulaiman AD.** Clinical Comparison between Diode Laser and Scalpel Inci-sions in Oral Soft Tissue Biopsy. *Al–Rafidain Dent J*. 2012; 12(2): 337-343.

75. **Akbulut N, Kursun ES, Tumer MK, Kamburoglu K, Gulsen U**. Is the 810-nm diode laser the best choice in oral soft tissue therapy? Eur J Dent 2013;7:207-11.

76. **Azma E, Safavi N.** Diode laser application in soft tissue oral surgery. J Lasers Med Sci. 2013;4(4):206211

77. **Ehsan Azma, Nassimeh Safavi**. Diode Laser Application in Soft Tissue Oral Surgery. J Lasers Med Sci 2013; 4(4):206-11

78. **Pai JB, Padma R, Divya Malagi S, Kamath V, Shridhar A, Mathews A**. Excision of fibroma with diode laser: a case series. J Dent Lasers. 2014;8(1):34-38.

79. **Mazarei Sotoode S, Azimi S, Taheri SA, et al**. Diode laser in minor oral surgery: a case series of laser removal of different benign exophytic lesions. J Lasers Med Sci. 2015;6(3):133-138

80. **M.B.F. Amaral, J.M.S. de A ´ vila, M.H.G. Abreu, R.A. Mesquita**: Diode laser surgery versus scalpel surgery in the

treatment of fibrous hyperplasia: a randomized clinical trial. Int. J. Oral Maxillofac. Surg. 2015.

81. **Huang IY, Chen CM, Kao YH, Worthington P**. Treatment of mucocele of the lower lip with carbon dioxide laser. J Oral Maxillofac Surg. 2007;65:855-8.
82. **Kopp WK, St-Hilaire H.** Mucosal preservation in the treatment of mucocele with $CO_2$ laser. J Oral Maxillofac Surg. 2004;62:1559-61.
83. **Frame JW.** Removal of oral soft tissue pathology with the CO2 laser. J Oral Maxillofac Surg. 1985;43:850-5.
84. **España AJ, Velasco V, Gay Escoda C, Berini L, Arnabat J.** Aplicacionesdel láser de CO2 en Odontología. Madrid: Ergon; 1995.
85. **Bornstein MM, Winzap-Kälin C, Cochran DL, Buser D**. The CO2 laser for excisional biopsies of oral lesions: a case series study. Int J Periodontics Restorative Dent. 2005;25:221-9.
86. **Karu T**. Photobiology of low power laser effects. Health Phys 1989;56:691-704.
87. **Smith K**. The photobiological basis of low-level laser radiation therapy. Laser Therapy 1991;3:19-24.
88. **Harris DM**. Biomolecular mechanisms of laser biostimulation. J Clin Laser Med Surg 1991;9:277-9.
89. **Elanchezhiyan S, Renukadevi R, Vennila K.**Comparison of diode laser-assisted surgery and conventional surgery in the

management of hereditary ankyloglossia in siblings: a case report with scientific review. Lasers Med Sci 2013;28:7–12.

90. **Asnaashari M, Mohebi S, Paymanpour P**. Pain reduction using low level laser irradiation in single-visit endodontic treatment. J Lasers Med Sci 2011;2(4):139-43.
91. **U. S. Pal, Balendra Pratap Singh, Vikas Verma**.Comparative evaluation of zinc oxide eugenol versus gelatin sponge soaked in plasma rich in growth factor in the treatment of dry socket: An initial study. Contemp Clin Dent. 4(1): 37-41,2015.
92. **Schorn MN**. Measurement of blood loss: review of the literature. *J Midwifery Womens Health.* 2016;**55**(1):20–7.
93. **A.B.Bataineh**, "Sensory nerve impairment following mandibular third molar surgery," *Journal of Oral and Maxillofacial Surgery*, vol. 59, no. 9, pp. 1012–1017, 2013.
94. **Clauser C .**Effect of incision and flap reflection on post-operative pain after removal of partially impacted mandibular third molars . Quintessence Int.2016 Dec 25(12) : 845-9
95. **Asnaashari M, Zadsirjan S.** Application of Laser in Oral Surgery. J Lasers Med Sci 2016;5(3):97-107.
96. **Mahitab Mahmoud Soliman**, **Sherifa Moustafa Sabra**. The use of Laser as a Treatment Modality for treatment of Impacted mandibular wisdom among patients. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 13, Issue 1, Ver. VIII (Feb. 2014), PP 67-75.

97. **Roynesdal AK, Bjornland T, Barkvoll P, Haanaes HR.** The effect of soft-laser application on postoperative pain and swelling. A double-blind, crossover study. Int J Oral Maxillofac Surg 1993;22:242–5.

# ANNEXURE

## ANNEXURE I - CASE REPORT FORM

## A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR , AN IN VIVO STUDY

PATIENT'S NAME : _____

AGE/ SEX : _____

PATIENT'S IDENTIFICATION NO : _____

CONTACT ADDRESS : _____ _____

CONTACT NO : _____

INSTITUTION : Madha Dental College & Hospital, Chennai -600 069.

CENTRE : Dept. of Oral & Maxillofacial Surgery, Madha Dental College and Hospital, Chennai - 600 069.

PATIENT'S IDENTIFICATION/OP NO: _____DATE:_____

DETAILS OF SURGERY PROCEDURE FOLLOWED: Surgical removal of impacted mandibular third molar

DURATION OF SURGERY :

ANY OTHER INFORMATION :

DETAILS OF DRUG THERAPY :

POST-OPERATIVE ASSESSMENT :

NAME OF THE INVESTIGATOR :

SIGNATURE OF INVESTIGATOR :

## ANNEXURE II - CASE SHEET PERFORMA

# A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR , AN IN VIVO STUDY

PATIENT'S NAME : _____

AGE/ SEX : _____

PATIENT'S

IDENTIFICATION NO : _____

CONTACTADDRESS:_____

CONTACT NO : _____

INSTITUTION : Madha Dental College & Hospital, Chennai - 600069.

CENTRE : Dept. of Oral & Maxillofacial Surgery,

Chennai - 600 069

CHIEF COMPLAINT:

HISTORY OF THE PRESENTING ILLNESS:

CLINICAL FINDINGS:

INVESTIGATIONS:

TREATMENT:

Procedure followed : Surgical Removal of impacted mandibular third molar

FOLLOW UP

NAME OF THE INVESTIGATOR :

SIGNATURE OF INVESTIGATOR:

## ANNEXURE III

## INFORMATION SHEET

- We, Form the department of Oral and Maxillofacial surgery, Madha Dental College and Hospital, Kundrathur, Chennai, are conducting a study A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR , AN IN VIVO STUDY.

- The privacy of the subjects in the research will be maintained throughout the study. In the event of publication or presentation resulting from the research, no personally identifiable information will be shared.

- Taking part in this study is voluntary. you are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

- The result of this special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator Signature of Patient

Date :

## தகவல் அறிக்கை படிவம்

- நாங்கள் மாதா பல் மருத்துவக் கல்லூரி மற்றும் மருத்துவமனையில் வாய்வழி அறுவை சிகிச்சையில் கீழ்த்தாடை ஞானப்பல் அறுவைசிகிச்சையின் கீரல் முறையின் ஸ்கால்பெல் மற்றும் லேசர்-ன் பலாபலன்களின் ஒரு ஒப்பீடின் ஆய்வு நடத்துகின்றோம். அதற்காக நோயாளிகளை தேர்வு செய்கிள்றோம்.

- இந்த ஆராய்ச்சியில் பங்கேற்கும் நோயாளியின் விபரங்கள் ஆய்வு முடியும் வரை இரகசியமாக வைக்கப்படும். ஆராய்ச்சியின் முடிவு பற்றிய பதிப்புகள் அல்லது வெளியீடுகளில் யாருடைய தனிப்பட்ட விபரங்களும் பகிர்ந்து கொள்ளப்படமாட்டாது.

- இந்த ஆராய்ச்சியில் பங்கேற்கும் உங்கள் முடிவு தன்னிச்சையானது. இந்த ஆராய்ச்சியில் பங்கேற்கும் எந்த நேரத்திலும் விலகிக் கொள்ளவதற்கு உங்களுக்கு வாய்ப்பு உள்ளது. உங்களின் இந்த தீர்மானத்தினால் உங்களுக்கு இம்மருத்துவமனையில் வழங்கப்படும் பயன்களில் எந்தவித மாற்றமும் இருக்காது.

- இந்த சிறப்பு ஆய்வின் முடிவுகள், இந்த ஆய்வின் முடிவில் அல்லது ஆய்வின்போது ஏற்படும் எதிர்மறையான விளைவுகளை அந்நோயாளியின் நலன் கருதியோ அல்லது சிகிச்சை அளிக்கும் பொருட்டோ தெரிவிக்கப்படும்.

ஆய்வாளரின் கையொப்பம் நோயாளியின் கையொப்பம்

தேதி :

## ANNEXURE IV

## INFORMED CONSENT FORM

# A COMPARISON OF THE EFFICACY OF SCALPEL VERSUS LASERS IN INCISION AND ITS INFLUENCE ON POST OPERATIVE COMPLICATIONS IN SURGICAL REMOVAL OF MANDIBULAR THIRD MOLAR , AN IN VIVO STUDY

Participant ID No:

"I have read the informed consent information, or it has been read to me in my own language. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this study, to disclose my personal information, photos for publication purpose and I understand that I have the right to withdraw from the study at any time without any way affecting my further medical care."

| | | |
|---|---|---|
| Date | Name of the participant | Signature/thumb impression |

"I have witnessed the accurate reading of the consent form to the potential participant and the individual has had an opportunity to ask questions. I confirm that the individual has given consent freely"

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Date | Name of the participant | Signature/thumb impression |

| | | |
|---|---|---|
| _____ | _____ | _____ |
| Date | Name of the Interviewer | Signature/thumb Interviewer |

## ANNEXURE V

மாதா பல்மருத்துவ கல்லூரி மற்றும் மருத்துவமனை

கீழ்த்தாடை ஞானப்பல் அறுவைசிகிச்சையின் கீரல் முறையின்

ஸ்கால்பெல் மற்றும் லேசர்-ன் பலாபலன்களின் ஒரு ஒப்பீடு

தேதி :

நோயாளியின் பெயர் : _____

வயது / பாலினம் : _____

புறநோயாளி ஏண் : _____

அறுவை சிகிச்சை மருத்துவ நிபுணரின் பெயர் : _____

சிகிச்சையின் பெயர் : _____

_____

அளிக்கப்படும் மயக்க மருந்தின் வகை : _____

எனது தற்போதைய வாய்நலம் குறித்தும் , அதற்கு உரிய அறுவை சிகிச்சை முறைகளையும் , மற்றும் அறுவை சிகிச்சை முறைகளையும், அறுவை சிகிச்சையினால் ஏற்படும் பின் விளைவுகளும் பல் மருத்துவர் முழுமையாக என்னிடம் கூறினார் . அதற்கான எனது சந்தேகங்களையும் பல் மருத்துவரிடம் கேட்டு தெளிவுபடுத்திக்கொண்டேன். மேலும், என் அறுவை சிகிச்சையின் போது தேவைப்படும் மயக்க மருந்துகள், பிற மருந்துகள் செலுத்த சம்மதிக்கின்றேன். நான் மனப்பூர்வமாக எனது அறுவை சிகிச்சைமுறை மற்றும் அதனால் வரும் பின் விளைவுகளையும் ஏற்றுக் கொள்கிறேன், மருத்துவர் கூறும் அறிவுரைகளும் கடைபிடிப்பேன்.

என் மருத்துவ குறிப்பேடுகளை, என்னுடைய புகைப்படங்களை இந்த ஆராய்ச்சியில் பயன் படுத்திக்கொள்ளவும் மற்றும் ஆராய்சி புத்தகங்களில் வெளியிடவும் மனப்புர்வமாக சம்மதிக்கின்றேன்.

நோயாளியின் உதவியாளர் /
பெற்றோரின் கையொப்பம் நோயாளியின் கையொப்பம்

அறுவை சிகிச்சை நிபுணரின் கையொப்பம் மருத்துவரின் கையொப்பம்

# ANNEXURE VI

| Master Chart :Group I Clinical Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S.NO** | **Age/Sex** | **Ease of Access** | **Time Required for Surgery** | **Wound Healing** | **Wound Infection** | **Dry Socket** | **Paresnthesia** | **Intra op Bleeding** |
| 1 | 21 / F | 2 | 28.35 | 5 | A | A | A | 25% |
| 2 | 30 / F | 2 | 29.38 | 5 | A | A | A | 50% |
| 3 | 28 / F | 2 | 33.3 | 4 | A | A | A | 100% |
| 4 | 25 / F | 2 | 34.28 | 4 | A | A | A | 50% |
| 5 | 44 / M | 1 | 26.25 | 1 | P | P | P | 100% |
| 6 | 22 / M | 2 | 28.38 | 4 | A | A | A | 25% |
| 7 | 29 / F | 1 | 29.25 | 4 | P | P | P | 50% |
| 8 | 25 / F | 2 | 31.25 | 4 | A | A | A | 50% |
| 9 | 32 / F | 1 | 32.35 | 2 | A | A | A | 50% |
| 10 | 39 / F | 2 | 27.37 | 4 | A | A | A | 100% |
| 11 | 30 / F | 2 | 29.25 | 4 | A | A | A | 25% |
| 12 | 30 / M | 1 | 30.45 | 1 | P | P | P | 50% |
| 13 | 25 / M | 2 | 30.48 | 4 | A | A | A | 50% |
| 14 | 30 / M | 2 | 32.28 | 3 | A | A | A | 100% |
| 15 | 28 / M | 1 | 31.18 | 4 | A | A | A | 25% |
| 16 | 33 / M | 2 | 33.14 | 2 | A | A | A | 25% |
| 17 | 30 / M | 2 | 30.45 | 3 | A | A | A | 50% |
| 18 | 25 / F | 2 | 32.12 | 3 | A | A | A | 50% |
| 19 | 19 / M | 2 | 26.27 | 4 | A | A | A | 100% |
| 20 | 27 / F | 2 | 20.58 | 3 | A | A | A | 50% |
| 21 | 22 / M | 2 | 29.21 | 5 | P | P | A | 50% |
| 22 | 21 / F | 1 | 30.38 | 4 | A | A | P | 50% |
| 23 | 22 / M | 2 | 30.48 | 4 | A | A | A | 25% |
| 24 | 26 / F | 2 | 29.11 | 3 | A | A | A | 50% |
| 25 | 32 / F | 2 | 27.29 | 4 | A | A | A | 100% |
| 26 | 23 / F | 2 | 28.58 | 5 | A | A | A | 50% |
| 27 | 21 / M | 2 | 29.56 | 4 | A | A | A | 50% |
| 28 | 23 / F | 2 | 31.45 | 4 | A | A | A | 50% |
| 29 | 30 / F | 2 | 39.48 | 3 | A | A | A | 50% |
| 30 | 30 / M | 2 | 40.48 | 4 | A | A | A | 50% |

**A-Absent P-Present**

| Group I : Clinical Parameters | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Percentage decrease in Mouth Opening | | | | | | Percentage Increase in Swelling | | | | | | Pain Score | | | | | |
| S.No | D1 | D3 | D7 | 2W | 1M | 2M | D1 | D3 | D7 | 2W | 1M | 2M | D1 | D3 | D7 | 2W | 1M | 2M |
| 1 | 43.76 | 40.36 | 20.11 | 7.81 | 1.12 | 0.18 | 10.18 | 9.09 | 3.11 | 0.01 | 0.01 | 0.10 | 0 | 4 | 2 | 2 | 0 | 0 |
| 2 | 41.26 | 38.26 | 17.02 | 5.98 | 1.09 | 0.27 | 10.01 | 10.17 | 3.52 | 1.01 | 0.02 | 0.02 | 6 | 4 | 2 | 1 | 0 | 0 |
| 3 | 39.78 | 36.38 | 16.38 | 6.71 | 2.39 | 0.09 | 11.12 | 10.04 | 2.31 | 0.07 | 1.01 | 0.05 | 6 | 3 | 2 | 1 | 0 | 0 |
| 4 | 32.21 | 29.28 | 14.31 | 4.31 | 2.77 | 0.07 | 10.05 | 10.02 | 3.30 | 1.42 | 0.05 | 0.01 | 6 | 4 | 2 | 1 | 0 | 0 |
| 5 | 37.28 | 34.31 | 17.01 | 6.78 | 4.12 | 0.03 | 11.13 | 13.04 | 2.60 | 1.22 | 0.25 | 0.12 | 6 | 4 | 1 | 1 | 0 | 0 |
| 6 | 35.29 | 33.01 | 13.08 | 7.78 | 3.49 | 1.11 | 12.00 | 10.18 | 3.82 | 0.27 | 0.36 | 0.04 | 6 | 5 | 2 | 1 | 0 | 0 |
| 7 | 39.21 | 36.78 | 19.90 | 11.10 | 2.81 | 0.76 | 12.07 | 12.09 | 2.01 | 1.23 | 0.38 | 0.01 | 6 | 4 | 4 | 1 | 0 | 0 |
| 8 | 40.01 | 37.58 | 20.01 | 6.81 | 1.09 | 0.85 | 10.02 | 13.62 | 3.52 | 1.42 | 0.40 | 0.03 | 5 | 5 | 3 | 1 | 2 | 0 |
| 9 | 41.08 | 39.31 | 22.78 | 6.67 | 0.99 | 0.11 | 13.04 | 12.07 | 1.00 | 0.31 | 0.10 | 0.11 | 5 | 5 | 2 | 1 | 1 | 0 |
| 10 | 37.76 | 34.71 | 17.08 | 5.87 | 1.71 | 0.71 | 13.62 | 11.64 | 1.52 | 0.37 | 0.15 | 0.09 | 8 | 5 | 3 | 1 | 1 | 0 |
| 11 | 36.26 | 32.31 | 16.08 | 4.39 | 2.06 | 0.19 | 10.02 | 10.03 | 4.08 | 0.41 | 0.25 | 0.10 | 8 | 6 | 3 | 1 | 1 | 0 |
| 12 | 38.28 | 34.31 | 19.78 | 10.11 | 3.01 | 0.19 | 10.03 | 10.08 | 2.07 | 0.50 | 0.15 | 0.12 | 8 | 6 | 3 | 1 | 1 | 0 |
| 13 | 39.21 | 36.11 | 17.01 | 12.31 | 3.32 | 0.16 | 12.02 | 10.01 | 1.73 | 1.71 | 0.20 | 0.01 | 6 | 3 | 2 | 1 | 1 | 0 |
| 14 | 42.74 | 39.28 | 19.28 | 4.21 | 2.81 | 0.13 | 13.05 | 11.12 | 1.07 | 1.53 | 1.02 | 0.03 | 6 | 5 | 3 | 1 | 1 | 0 |
| 15 | 43.71 | 40.41 | 20.08 | 7.09 | 2.61 | 0.98 | 14.01 | 12.00 | 2.00 | 0.93 | 0.50 | 0.11 | 8 | 5 | 3 | 1 | 0 | 0 |
| 16 | 41.04 | 39.31 | 19.21 | 7.91 | 2.41 | 0.78 | 15.07 | 9.10 | 2.73 | 0.73 | 0.60 | 0.13 | 8 | 4 | 3 | 1 | 1 | 0 |
| 17 | 40.28 | 37.28 | 16.71 | 6.28 | 3.01 | 0.21 | 14.03 | 9.43 | 3.42 | 1.05 | 0.75 | 0.01 | 6 | 5 | 2 | 1 | 1 | 0 |
| 18 | 37.76 | 34.34 | 14.98 | 5.41 | 0.78 | 0.47 | 12.03 | 10.18 | 2.56 | 1.43 | 0.85 | 0.05 | 6 | 5 | 2 | 1 | 0 | 0 |
| 19 | 39.31 | 36.61 | 17.43 | 3.28 | 0.99 | 0.31 | 10.12 | 13.62 | 2.05 | 0.47 | 0.15 | 0.07 | 5 | 6 | 2 | 1 | 1 | 0 |
| 20 | 37.73 | 34.73 | 14.73 | 9.91 | 0.76 | 0.21 | 10.18 | 11.64 | 3.53 | 0.38 | 0.25 | 0.02 | 6 | 5 | 3 | 1 | 1 | 1 |
| 21 | 41.12 | 39.01 | 16.78 | 8.31 | 1.01 | 0.19 | 15.01 | 12.07 | 1.64 | 0.76 | 0.65 | 0.07 | 6 | 4 | 1 | 1 | 0 | 0 |
| 22 | 42.34 | 39.98 | 20.21 | 7.71 | 0.21 | 0.20 | 12.09 | 10.75 | 4.08 | 0.89 | 0.37 | 0.11 | 6 | 4 | 1 | 1 | 0 | 0 |
| 23 | 43.73 | 40.91 | 21.22 | 6.51 | 0.93 | 0.17 | 12.03 | 14.00 | 3.97 | 1.43 | 0.54 | 0.04 | 6 | 4 | 1 | 1 | 1 | 0 |
| 24 | 39.76 | 36.31 | 19.39 | 4.91 | 0.11 | 0.14 | 12.11 | 10.03 | 4.00 | 0.23 | 1.00 | 0.06 | 7 | 5 | 2 | 1 | 1 | 0 |
| 25 | 41.72 | 39.21 | 20.47 | 3.81 | 0.31 | 0.16 | 11.64 | 13.04 | 2.50 | 1.43 | 0.22 | 0.10 | 7 | 6 | 2 | 1 | 0 | 0 |
| 26 | 43.01 | 40.01 | 19.31 | 2.71 | 0.41 | 0.12 | 12.07 | 14.00 | 2.78 | 0.93 | 0.32 | 0.07 | 7 | 4 | 3 | 1 | 1 | 0 |
| 27 | 39.78 | 36.76 | 14.98 | 1.12 | 0.81 | 0.09 | 10.75 | 10.18 | 1.56 | 0.63 | 0.43 | 0.01 | 8 | 4 | 3 | 1 | 0 | 0 |
| 28 | 41.72 | 39.79 | 20.98 | 7.98 | 1.09 | 0.07 | 14.05 | 10.01 | 2.76 | 0.74 | 0.44 | 0.02 | 7 | 4 | 2 | 1 | 1 | 0 |
| 29 | 43.21 | 41.41 | 19.81 | 6.79 | 1.71 | 0.02 | 10.08 | 11.12 | 2.57 | 0.98 | 0.57 | 0.04 | 7 | 5 | 3 | 1 | 1 | 0 |
| 30 | 40.31 | 37.06 | 21.01 | 5.56 | 0.76 | 0.19 | 10.03 | 10.05 | 2.33 | 1.05 | 0.63 | 0.06 | 7 | 4 | 3 | 1 | 1 | 0 |

**D1 - Day1, D3 - Day 3, D7 - Day 7, 2W - 2Week, 1M - 1st Month, 2M - 2nd Month**

| Master Chart :Group II Clinical Parameters | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **S.NO** | **Age/Sex** | **Ease of Access** | **Time Required for Surgery** | **Wound Healing** | **Wound Infection** | **Dry Socket** | **Parenthesia** | **Intra o/p Bleeding** |
| 1 | 21 / F | 2 | 20.25 | 5 | A | A | A | 25% |
| 2 | 30 / F | 2 | 28.35 | 5 | p | A | p | 25% |
| 3 | 28 / F | 2 | 22.12 | 4 | A | A | A | 25% |
| 4 | 25 / F | 2 | 21.37 | 4 | A | A | A | 50% |
| 5 | 44 / M | 2 | 26.28 | 1 | A | p | A | 25% |
| 6 | 22 / M | 2 | 28.35 | 5 | A | A | A | 0% |
| 7 | 29 / F | 2 | 23.39 | 5 | A | A | p | 25% |
| 8 | 25 / F | 2 | 27.45 | 5 | A | A | A | 25% |
| 9 | 32 / F | 2 | 32.35 | 3 | p | p | A | 25% |
| 10 | 39 / F | 2 | 19.18 | 5 | A | A | A | 50% |
| 11 | 30 / F | 2 | 20.12 | 5 | A | A | A | 0% |
| 12 | 30 / M | 2 | 18.16 | 3 | A | A | A | 25% |
| 13 | 25 / M | 2 | 22.25 | 5 | A | A | A | 25% |
| 14 | 30 / M | 2 | 20.45 | 4 | A | A | A | 50% |
| 15 | 28 / M | 2 | 24.35 | 5 | A | A | A | 0% |
| 16 | 33 / M | 2 | 19.01 | 3 | A | A | A | 0% |
| 17 | 30 / M | 2 | 20.35 | 5 | A | A | A | 25% |
| 18 | 25 / F | 2 | 18.58 | 5 | A | A | A | 25% |
| 19 | 19 / M | 2 | 17.58 | 5 | A | A | A | 50% |
| 20 | 27 / F | 2 | 23.51 | 4 | A | A | A | 25% |
| 21 | 22 / M | 2 | 22.32 | 3 | A | A | A | 25% |
| 22 | 21 / F | 2 | 20.29 | 4 | A | A | P | 25% |
| 23 | 22 / M | 2 | 19.28 | 4 | A | A | A | 0% |
| 24 | 26 / F | 2 | 17.54 | 5 | A | A | A | 25% |
| 25 | 32 / F | 2 | 19.51 | 5 | A | A | A | 50% |
| 26 | 23 / F | 2 | 22.21 | 4 | A | A | A | 0% |
| 27 | 21 / M | 2 | 21.29 | 5 | A | A | A | 25% |
| 28 | 23 / F | 2 | 19.51 | 4 | A | A | A | 0% |
| 29 | 30 / F | 2 | 20.29 | 5 | A | A | A | 25% |
| 30 | 30 / M | 2 | 24.51 | 1 | A | A | A | 0% |

**A-Absent P-Present**

| Group II : Clinical Parameters | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Percentage decrease in Mouth Opening | | | | | | Percentage Increase in Swelling | | | | | | Pain Score | | | | | |
| S.No | D1 | D3 | D7 | 2W | 1M | 2M | D1 | D3 | D7 | 2W | 1M | 2M | D1 | D3 | D7 | 2W | 1M | 2M |
| 1 | 24.73 | 15.75 | 7.45 | 4.31 | 1.08 | 0.00 | 8.03 | 5.01 | 1.05 | 0.05 | 0.01 | 0.00 | 5 | 3 | 1 | 0 | 0 | 0 |
| 2 | 22.76 | 17.35 | 10.21 | 3.19 | 1.19 | 0.12 | 8.09 | 5.53 | 1.25 | 0.01 | 0.03 | 0.01 | 4 | 4 | 1 | 0 | 0 | 0 |
| 3 | 33.23 | 27.37 | 19.11 | 4.09 | 1.81 | 0.09 | 8.57 | 5.11 | 1.57 | 0.30 | 0.06 | 0.02 | 5 | 4 | 1 | 0 | 0 | 0 |
| 4 | 35.27 | 29.48 | 14.14 | 3.01 | 1.97 | 0.01 | 9.07 | 6.75 | 0.95 | 0.22 | 0.10 | 0.04 | 6 | 7 | 1 | 0 | 0 | 0 |
| 5 | 32.41 | 27.71 | 13.78 | 5.68 | 0.98 | 0.05 | 9.11 | 8.25 | 1.72 | 0.08 | 0.05 | 0.09 | 5 | 4 | 1 | 0 | 0 | 0 |
| 6 | 31.12 | 28.01 | 14.78 | 3.78 | 0.76 | 0.09 | 9.75 | 7.05 | 1.32 | 0.21 | 0.11 | 0.01 | 6 | 4 | 1 | 0 | 0 | 0 |
| 7 | 30.39 | 20.31 | 12.91 | 2.91 | 0.49 | 0.00 | 8.75 | 7.25 | 1.09 | 0.08 | 0.13 | 0.07 | 7 | 4 | 1 | 0 | 0 | 0 |
| 8 | 40.41 | 35.31 | 17.31 | 6.71 | 0.71 | 0.00 | 10.01 | 7.37 | 1.50 | 0.30 | 0.08 | 0.06 | 6 | 4 | 1 | 0 | 0 | 0 |
| 9 | 25.51 | 20.21 | 12.01 | 5.76 | 0.56 | 0.76 | 10.02 | 7.02 | 2.00 | 0.25 | 0.02 | 0.05 | 7 | 4 | 2 | 0 | 0 | 0 |
| 10 | 29.83 | 22.83 | 11.79 | 4.71 | 1.03 | 0.29 | 8.75 | 6.32 | 1.07 | 0.32 | 0.01 | 0.06 | 7 | 5 | 1 | 0 | 0 | 0 |
| 11 | 27.71 | 23.46 | 13.16 | 3.31 | 0.99 | 0.37 | 9.62 | 6.45 | 0.98 | 0.20 | 0.04 | 0.01 | 7 | 3 | 1 | 0 | 0 | 0 |
| 12 | 26.71 | 21.81 | 14.71 | 2.11 | 0.77 | 0.29 | 9.57 | 6.13 | 1.57 | 0.18 | 0.03 | 0.03 | 8 | 5 | 1 | 0 | 0 | 0 |
| 13 | 24.31 | 19.19 | 13.16 | 1.98 | 0.48 | 0.21 | 9.72 | 6.43 | 1.72 | 0.15 | 0.07 | 0.01 | 8 | 4 | 1 | 0 | 0 | 0 |
| 14 | 32.01 | 27.78 | 22.38 | 4.71 | 0.81 | 0.09 | 10.08 | 6.73 | 1.57 | 0.13 | 0.12 | 0.02 | 6 | 5 | 1 | 0 | 0 | 0 |
| 15 | 31.98 | 28.76 | 14.46 | 5.98 | 0.77 | 0.07 | 8.72 | 7.43 | 0.87 | 0.37 | 0.11 | 0.04 | 6 | 5 | 1 | 0 | 0 | 0 |
| 16 | 33.56 | 29.91 | 17.71 | 7.71 | 0.91 | 0.03 | 8.63 | 8.05 | 1.75 | 0.28 | 0.10 | 0.05 | 8 | 5 | 1 | 0 | 0 | 0 |
| 17 | 35.51 | 31.76 | 15.96 | 4.17 | 0.31 | 0.01 | 9.85 | 8.72 | 1.87 | 0.09 | 0.09 | 0.07 | 5 | 4 | 1 | 0 | 0 | 0 |
| 18 | 37.78 | 33.56 | 17.21 | 5.78 | 0.95 | 0.00 | 8.13 | 8.63 | 1.68 | 0.11 | 0.06 | 0.03 | 4 | 4 | 1 | 0 | 0 | 0 |
| 19 | 40.01 | 32.41 | 13.31 | 6.71 | 1.15 | 0.32 | 7.95 | 5.73 | 1.99 | 0.13 | 0.04 | 0.02 | 6 | 5 | 1 | 0 | 0 | 0 |
| 20 | 41.79 | 37.29 | 11.21 | 4.28 | 1.71 | 1.01 | 8.00 | 5.64 | 2.02 | 0.18 | 0.05 | 0.03 | 7 | 5 | 1 | 0 | 0 | 0 |
| 21 | 42.29 | 39.19 | 16.19 | 3.01 | 1.43 | 0.97 | 8.65 | 6.47 | 1.63 | 0.20 | 0.03 | 0.01 | 7 | 5 | 2 | 0 | 0 | 0 |
| 22 | 30.01 | 25.17 | 14.17 | 7.71 | 1.32 | 0.83 | 8.20 | 6.74 | 1.05 | 0.10 | 0.06 | 0.03 | 6 | 5 | 2 | 0 | 0 | 0 |
| 23 | 29.56 | 25.46 | 13.28 | 4.29 | 0.79 | 0.31 | 9.50 | 8.37 | 1.27 | 0.11 | 0.08 | 0.04 | 7 | 5 | 2 | 0 | 0 | 0 |
| 24 | 22.38 | 17.18 | 9.29 | 6.01 | 0.89 | 0.04 | 9.15 | 8.74 | 1.30 | 0.15 | 0.09 | 0.08 | 8 | 5 | 1 | 0 | 0 | 0 |
| 25 | 30.01 | 26.78 | 13.17 | 5.28 | 0.31 | 0.07 | 8.25 | 8.63 | 1.79 | 0.18 | 0.11 | 0.05 | 8 | 5 | 1 | 0 | 0 | 0 |
| 26 | 29.78 | 23.38 | 14.38 | 4.71 | 0.22 | 0.00 | 8.05 | 8.07 | 1.80 | 0.02 | 0.12 | 0.06 | 8 | 4 | 2 | 0 | 0 | 0 |
| 27 | 28.98 | 23.56 | 11.49 | 3.98 | 0.41 | 0.00 | 7.56 | 7.57 | 2.00 | 0.04 | 0.10 | 0.05 | 7 | 5 | 1 | 0 | 0 | 0 |
| 28 | 25.31 | 21.01 | 13.79 | 2.71 | 0.73 | 0.41 | 9.52 | 7.45 | 1.50 | 0.74 | 0.03 | 0.01 | 7 | 5 | 1 | 0 | 0 | 0 |
| 29 | 27.01 | 21.79 | 16.58 | 1.98 | 0.69 | 0.32 | 9.05 | 7.25 | 1.43 | 0.17 | 0.02 | 0.01 | 7 | 5 | 1 | 0 | 0 | 0 |
| 30 | 20.78 | 14.28 | 7.21 | 1.41 | 0.56 | 0.11 | 9.11 | 7.05 | 1.60 | 0.16 | 0.07 | 0.00 | 8 | 5 | 1 | 0 | 0 | 0 |

**D1 - Day1, D3 - Day 3, D7 - Day 7, 2W - 2Week, 1M - 1st Month, 2M - 2nd Month**

URKUND

## Urkund Analysis Result

| | |
|---|---|
| Analysed Document: | A plagiarism check thesis.docx (D34335365) |
| Submitted: | 1/4/2018 8:46:00 AM |
| Submitted By: | bharathi221992@gmail.com |
| Significance: | 1 % |

### Sources included in the report:

2354117A_DENT5077_Essay.docx (D33577315)
2221917S_OMFS1Dentoalveolar_Essay.docx (D33550016)

### Instances where selected sources appear:

3